



FEDERATION OF MALAYA

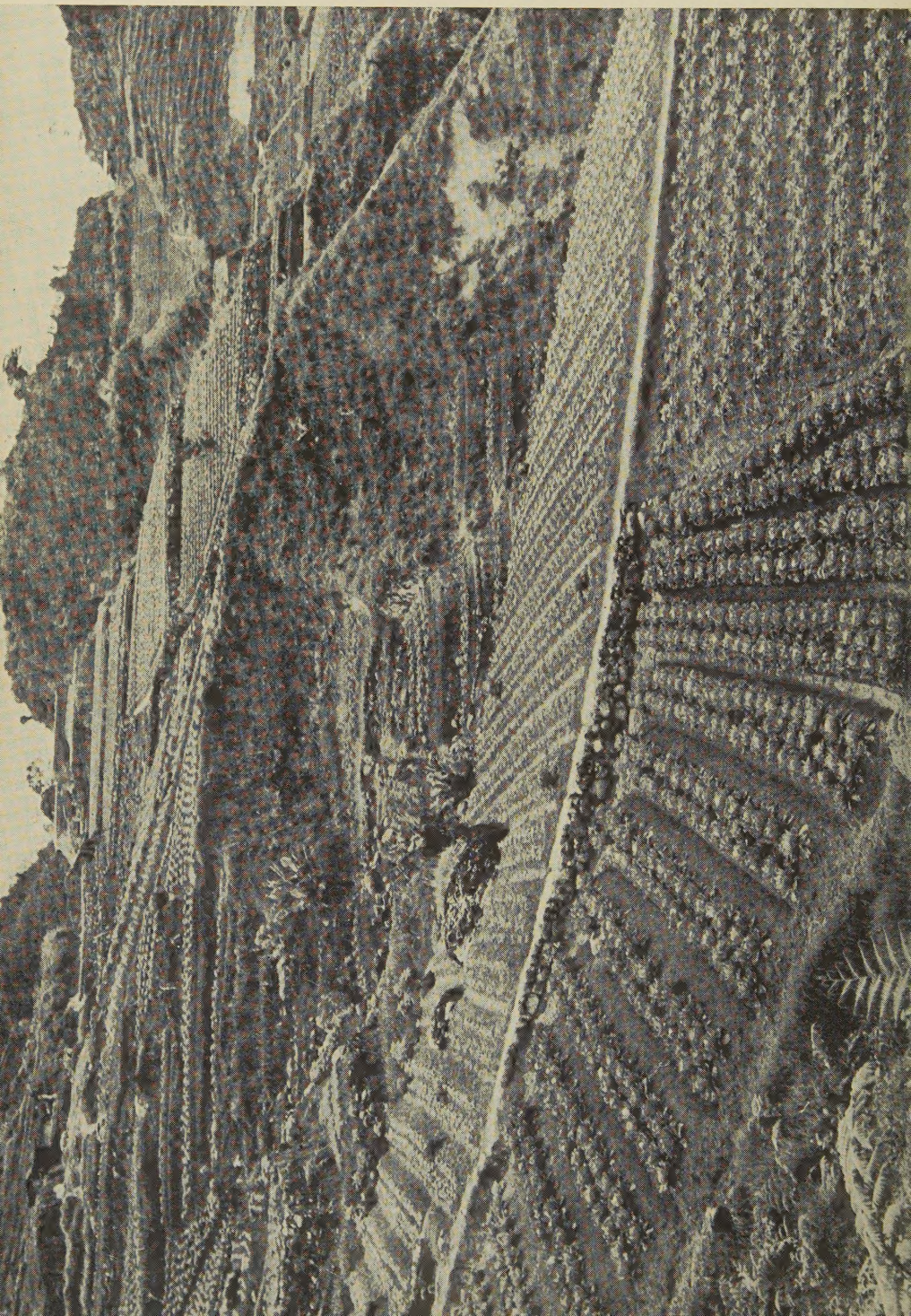
ANNUAL REPORT
OF THE
DEPARTMENT OF AGRICULTURE
FOR THE YEAR
1954

By
R. G. HEATH,
*Acting Director of Agriculture,
Federation of Malaya*

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NEW VILLAGE
AGRICULTURE
IN THE HIGHLANDS





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ANNUAL REPORT OF THE DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA, FOR THE YEAR 1954

SECTION I

POLICY

The broad lines of agricultural policy have remained unchanged. As summarised in the Report for 1950 and 1951, they are as follows:

- To increase the agricultural production of the Federation while at the same time maintaining soil fertility;
- To diversify the agricultural economy of the Federation;
- To intensify agricultural production so that each cultivated acre supports larger yields of crops and/or livestock;
- To increase the production of foodstuffs with particular emphasis on rice.

ORGANISATION OF THE DEPARTMENT

2. As mentioned in the 1953 Report, the term "Department of Agriculture," in so far as the Federation of Malaya is concerned, embraces no less than 12 Departments—one Federal, two Settlement and nine State. Organisation on this basis is assisted by the fact that the Federation Agreement lays it down that research is the function of the Federal Government and extension work that of the State and Settlement Governments. Administrative difficulties are not unknown, as is inevitable in an organisation of such nature, but experience has shown that provided close contact is maintained between the Headquarters staff of the Federal Department and the senior executive officers of the State and Settlement Governments, the majority of such difficulties can be overcome in reasonable degree. The system demands of those officers of the Department who serve in the States and Settlements, *esprit de corps* of a high order from the common Departmental standpoint and the ability, where necessary, to reconcile differing points of view in a manner not disadvantageous to the work of the Department as a whole.

FINANCE

3. The Department was one of those selected for heavy cuts in connection with the Federal Estimates for 1954. As compared with 1953, annually recurrent expenditure was less by approximately \$500,000, which represented a cut of roughly one-third in extent. The effect of this on the programme of research and investigations, which of necessity is planned not on a short term basis but to cover a period of years, was indeed serious. Initially it appeared that many valuable lines of work would have to be scrapped. Fortunately, however, it proved possible to avoid severe

dislocation of the programme in general as the result of the prompt and timely assistance rendered by Her Majesty's Government in the shape of Colonial Development and Welfare funds for the continuation of work on a number of investigation projects of importance.

4. In contrast to those of the Federal Department, the various Estimates of the State and Settlement Departments, with one exception, showed increases as compared with 1953.

STAFF

5. After several years in the doldrums, recruitment of senior staff has greatly improved from 1952 onwards. At its worst, in mid-1952, the strength of senior staff, on the ground, was below 40 per cent. At the close of 1954, it stood at approximately 80 per cent.

6. In the degree of experience of its senior staff, the Department may be said to possess a shrinking head, virtually no body and a prodigious tail. The head, consisting of officers with pre-war experience, was 14 in number at the end of 1954 with two more due to depart on retirement during the first few months of 1955. The body, of immediate post-war recruits, numbers three. The length of the tail is illustrated by the fact that over 50 per cent. of the senior officers are on their first tour of service, and over 70 per cent. on their first or second tour. The strain thrown on the small number of experienced officers in training such a large number of recruits is considerable.

7. The number of Asian officers holding senior appointments increased from four to six during the year. A further eight are undergoing training overseas with a view to filling such appointments.

8. Recruitment of Agricultural Assistants is in prospect of considerable improvement from 1955 onwards in view of the full intake of Major Scholars at the College of Agriculture which has been a feature from the 1952-53 academic year onwards. At the end of the year there were 33 vacancies for this class of officer.

PROGRESS IN 1954

9. Factors of importance affecting the work and progress of the Department in 1954, aside from those mentioned above, have been as follows:

- (1) The preparation of a provisional Draft Development Plan for the Department covering the period 1955-59. This is being reviewed at intervals pending Treasury advice as to its implementation, in whole or in part.
- (2) The visit of the International Bank Mission from March to May. Considerable assistance was rendered to the agricultural members of the Mission in the carrying out of their survey of local conditions.
- (3) The production of two important papers, one on the functions of the Department and one on the extension

services of the Department, which received the approval of the Federal Government.

- (4) The setting up by the Member for Natural Resources of a working party to prepare, in broad outline, a plan for the development of a cacao industry in the Federation. Considerable strides were made during the year in determining the most suitable cultivation techniques in respect of this crop in Malaya.
- (5) The visit and report of the Mission of Enquiry into the rubber industry of Malaya.
- (6) The very considerably improved position as regards the supply by the Department of improved planting material for replanting and new planting of rubber by smallholders.
- (7) The reaching of a stage in the work on fertilisers for padi where it is now possible to make specific recommendations for fertiliser application in the majority of the main padi growing areas.
- (8) The first large scale distributions have taken place of selected strains of padi developed as the result of the post-war programme of selection and breeding work on this crop.
- (9) The stabilisation of new village agriculture, in which the Department has played a not inconsiderable part, with the result that the acreage of food crops other than padi has now regained the pre-Emergency level.
- (10) The considerable amount of soil survey work now being carried out, both for specific purposes and as part of the general soil survey of the Federation.
- (11) The inauguration of much needed surveys into the economics of smallholding agriculture.
- (12) The discussions held with the Oil Palm Committee of the United Planting Association of Malaya with a view to the centralising of selection and breeding work on the crop.
- (13) The recommencement of selection and breeding work on coconuts, in abeyance since the former Federal Experiment Station, Port Swettenham, was lost to the Department in 1949.
- (14) The large increase in the output of budded fruit plants for distribution to smallholders.
- (15) Colonial Development and Welfare funds were made available during the year for tests on a unit holding basis of the practicability of utilising mechanical methods, wholly or in part, in the cultivation of padi by smallholders. It is hoped to commence work in 1955.

10. The above list is by no means exhaustive but it does summarise some of the main lines of work which have progressed during the year. The work of the Department is described in detail from Section IV of the Report onwards.

GENERAL

11. In concluding this section of the Report, mention must again be made of the excellent work carried out by the staff, of all ranks, in circumstances not always easy. In particular, the work of those officers who operate in areas which are regarded as bad from the security angle has been of exceptional merit. Their activities are seldom, if ever, publicised; nevertheless, the fact that the work of the Department has been maintained and developed over the past few years, in the great majority of areas, with the minimum of dislocation is eloquent testimony to their sense of duty.

SECTION II

AGRICULTURE IN THE FEDERATION OF MALAYA

A.—WEATHER

12. The year was one of marked contrasts with the seasonal dry and wet spells abnormally intense, giving rise in the north to drier, and in the south to wetter, conditions than were generally expected. Rainfall was badly distributed, precipitations in excess of 10 in. in 24 hours being reported on several occasions in the south: localised flooding was frequent and widespread. In brief, weather conditions during 1954 were not conducive to maximum cropping.

B.—CROP REPORTS

(i) RUBBER

13. Comparative acreages under rubber in the Federation are as follows:

Calendar Year		Estates (Acres)		Smallholdings (Acres)		Total (Acres)
1950	..	1,964,370	..	1,393,881	..	3,358,251
1951	..	1,963,735	..	1,571,486	..	3,535,221
1952	..	1,996,727	..	1,616,093	..	3,612,820
1953	..	2,029,706	..	1,697,834	..	3,727,540
1954	..	Not available at time of writing				

14. Production figures for the Federation are given in the following table:

Calendar Year		Estates (Tons)		Smallholdings (Tons)		Total (Tons)
1950	..	375,853	..	316,732	..	692,585
1951	..	327,956	..	275,924	..	603,880
1952	..	341,078	..	241,571	..	582,649
1953	..	341,117	..	231,675	..	572,792
1954	..	342,806	..	240,230	..	583,036

15. The Pan-Malayan imports and exports of rubber during the same periods were:

Calendar Year		Gross Exports (Tons)		Gross Imports (Tons)		Net Exports (Tons)
1950	..	1,106,500	..	448,655	..	657,845
1951	..	1,155,277	..	547,107	..	608,170
1952	..	910,420	..	338,855	..	571,565
1953	..	847,213	..	277,533	..	569,680
1954	..	915,114	..	344,158	..	570,956

16. The steady decline in the average price of rubber which characterised 1953 continued until the end of March, 1954, when it was checked to give place to a steady if unspectacular upward trend which raised the price to 70 cents per lb. in July (the highest price since May, 1953) and to 98.5 cents per lb. on the 31st December. The recorded monthly average prices of No. 1 R.S.S. (Ribbed Smoked Sheet) in January and December were 55.88 and 86.15 cents per lb. respectively.

17. Since the estate industry demands the careful and efficient management of a long-term asset, production would not be expected to react sharply to price variations; nor did it. The smallness of the increase in estate production recorded in 1954—1,689 tons—was not entirely due to that factor, however, for output is also governed by the extensive replanting programme undertaken by estates since the war, and a period of static or even declining production must be accepted until the replanted areas come into full bearing. Smallholding production in 1954 topped that of 1953 by some 8,555 tons, the increase undoubtedly arising from the stimulus of improved prices during the second half of the year.

18. Rubber in Malaya is generally marketed in the form of Ribbed Smoked Sheet, Crepe and Preserved Latex. Small quantities of specialised types such as Rubber Powder and Cyclised Rubber were also produced. One interesting feature of the market trend shown by an analysis of exports for the last few years is that Preserved Latex accounted for a higher percentage (10 per cent.) of total exports in 1954 than ever before.

19. The marketing of technically classified rubber (T.C.R.) continued to receive increased support and the system was gradually being extended to embrace smallholding produce, the bulk of which is still, unfortunately, of sub-standard quality. Latex marketing schemes, introduced with the dual purpose of improving the quality of the rubber produced by smallholders and of increasing the value to the smallholder of his crop, have not in practice fulfilled their early promise and have made little headway in the last year or two.

20. As evidenced by production figures, the incidence of tapping on smallholdings was not significantly arrested by the low prices prevailing during the first quarter. What was noticeable, however, was the changeover from family tapping during that period to tapping by hired labour when prices improved later in the year.

21. The future of Malaya's rubber industry was the subject of an enquiry by a fact-finding mission under the chairmanship of Sir Francis Mudie, K.C.S.I., K.C.I.E., O.B.E. Favourable comment was made in support of the Rubber Replanting Scheme, details of which were published in the Annual Report for 1952. In regard to Fund "A", the Administrators have to-date repaid to estates of 100 acres or more a total of \$74,620,700 collected in the form of a cess on rubber exports.

22. Smallholding interests are the concern of the Administrators of Fund "B", under whose direction the Smallholders'

Replanting Organisation functions. The aim is to replant a total of 500,000 acres of smallholding rubber in six years from the date of the Scheme's inception, i.e. 1952. Of necessity, having regard to the need for staff recruitment and training as well as the need for publicity in the early stages, the annual target for replanting was graded, commencing with 40,000 acres in the first year and ending with 90,000 acres in the final year. The whole undertaking is a most formidable one and there are few, if any, schemes elsewhere in tropical agriculture of equal magnitude and importance.

23. The replanting target of 50,000 acres for 1954 was not reached. Of 12,981 applications to replant rubber on 51,691 acres, only 9,895, totalling 34,807 acres, fulfilled the stipulated conditions and received the necessary approval. By the end of December, 7,398 of the approved applicants, with a total of 21,504 acres, had received the first cash grant which is payable when felling, clearing, lining and holing are completed and authority given to commence planting.

24. When conditions are suitable, encouragement is given to replant with crops other than rubber, the same scale of grant as in the case of rubber being paid. This policy resulted in 1954 in 1,520 applicants (4,221 acres) from a total of 2,076 (6,272 acres) receiving approval to replant with approved crops.

25. From the date of commencement of the Scheme, 49,701.5 acres has been replanted with high yielding rubber and 3,461 acres with approved alternative crops. The latter comprised fruit (1,010 acres), coconuts (865.5 acres), coffee (878 acres), padi (545 acres), pineapples (161 acres) and sago (2 acres). Up till the end of 1954 the approximate total financial outlay under Schemes 1 and 2 of Fund "B" amounted to \$8,250,000.

26. A high standard of maintenance in replanted holdings is exacted and cash grants may be withheld if maintenance is found to be sub-standard. In regard to lalang (*Imperata cylindrica*) in particular, full and complete eradication is demanded on the grounds that once it becomes firmly established, not only will the replanted rubber be several years late in coming into bearing but yields may be permanently impaired and the advantage accruing from the use of high yielding material very greatly reduced.

27. To the smallholder, lacking mechanical aids, the task of replanting calls for hard and sustained physical labour. No opportunity is neglected, therefore, of discovering ways and means to lighten his burden. To give an instance, the hormone 2:4:5-T, when tested as a tree killer, was shown to be of distinct promise and its organised use to kill old rubber is likely to be widely extended in 1955.

28. In November, 1954, the total grant payable to smallholders was raised from \$400 to \$500 per acre with payment made retrospectively. Even with this additional incentive, what precisely will be the effect on next year's replanting programme should higher prices prevail from December onwards is still unknown.



Young cacao in a
"phosphate only"
plot of a manurial
experiment



Young cacao, in the same
experiment, which has
received nitrogen but no
phosphate



Mechanical cultivation of padi. A prototype mounted Kedah roll developed by the Department in Kelantan



Intensive production of budded fruit plants by the Department with the aid of overhead irrigation

29. The new planting of rubber continued, principally in Kedah, Kelantan, Trengganu, Perak and Pahang.

30. The current prices of 25 cents per yard and 15 cents per seedling charged to the smallholder for budwood and clonal seedlings are equated to commercial costs, and on an acreage basis the cost is approximately \$30 for either clonal seedlings or budlings, including budgrafting.

(ii) RICE

31. The 1953-54 season saw increased interest in padi planting with a nett gain in the planted acreage of 11,980 acres over the previous season. Unfortunately, however, adverse weather conditions during the season were such as to offset the anticipated gain in production from the increased acreage planted. Of the main padi growing States, those on the east coast were the worst affected by the weather, fully 18,000 planted acres being ruined by either floods or drought. Despite, therefore, the growing use of high yielding seed and fertiliser and the considerable improvements effected in drainage and irrigation, Malaya's unpredictable weather still remains the vital deciding factor in crop yields.

32. An increase of upwards of 20,000 acres is reasonably certain in the planted acreages for the 1954-55 season and should make it, on acreage, the best for the last four seasons. The following table gives comparative figures for acreages under wet and dry padi together with yields since 1949:

Season	WET PADI			DRY PADI			TOTAL PADI	
	Acreage (Planted)	Yield (Tons)		Acreage (Planted)	Yield (Tons)		Acreage (Planted)	Yield (Tons)
1949-50 ..	871,470	667,485	..	59,060	24,425	..	930,530	691,910
1950-51 ..	828,590	684,668	..	46,800	18,255	..	875,390	702,923
1951-52 ..	790,110	525,713	..	40,940	15,668	..	831,050	541,381
1952-53 ..	789,840	683,795	..	44,170	16,288	..	834,010	700,083
1953-54 ..	808,760	634,935	..	37,230	13,032	..	845,990	647,967

33. Dry padi accounts for a relatively insignificant portion of the total area planted with padi; on acreage it amounts to roughly 4.6 per cent. and on production, because of consistently lower average yields, to only 2 per cent. Included in the above table are data relating to double cropping with wet padi which, although amounting to only just over 1 per cent. of the total main crop acreage in 1954, is nevertheless receiving increased attention where controlled irrigation is possible, and acreages have doubled over the last three seasons.

34. When weather permits, there is no doubt that padi is being grown more and more efficiently, but the yield increases per unit area do no more than keep pace with the additional requirements of a steadily growing population. The ratio therefore of production to consumption has varied very little since the war.

35. Production, with very few minor exceptions, is in the hands of the Malays, while milling and marketing are almost entirely a Chinese monopoly. The price of imported rice declined steadily during 1954. Following this decline in price, the Government guaranteed minimum or support price for locally grown padi

was reduced from $12\frac{3}{4}$ to 9 cents per lb. Nevertheless, it was noted with interest that in December the market price of local padi was still above that of the support price. The easing of tension in international rice affairs and the existence of substantial rice stocks surplus to world requirements are not accepted as grounds for reducing output in Malaya, and intensification of local production by opening up potential new areas and improving existing areas, the extended use of high yielding strains and fertilisers and the introduction of improved field techniques remains the policy of Government.

36. Under Malayan conditions, padi suffers comparatively little from diseases, an unidentified complex known as *Penyakit merah* being probably the most important. Pests, on the other hand, particularly rats and stem borers, cause considerable damage to crops annually and there is scope for the extension of organised pest control measures.

37. For the third year in succession a subsidised padi fertiliser scheme was in operation on the East Coast. Results were again disappointing, only 345 tons of the approved fertiliser mixture being bought, i.e., sufficient for about 1.6 per cent. of the planted acreage, as against 719.3 tons in 1953—a season of extremely adverse weather conditions. Reasons quoted for the general lack of support were the absence of ready cash and the low rate of subsidy—the rate had been reduced from \$6 for 100 lb. in 1953 to \$4 in 1954. In contrast, it is estimated that farmers in Kedah and Perlis purchased 490 tons of imported fertilisers at unsubsidised rates in addition to the usual large quantities of bat guano.

38. Post-war botanical research and agronomic investigations have progressed sufficiently far to permit the extensive demonstration on farmers' land of new padi selections and improved strains as well as improved techniques of planting and the use of fertiliser.

39. Excellent progress was made in the survey and soil sampling of the large acreage of potential padi land in the Trans-Perak area.

40. The problems of rice mechanisation up to the stage of planting have largely been solved, but those relating to planting and harvesting still present difficulties.

41. Data in regard to annual Pan-Malayan retained imports of rice and costs are given in the following table:

NET IMPORTS OF RICE
(Pan-Malayan)

Year		Tons		Value in \$
1950	..	435,958	..	175,585,707
1951	..	498,929	..	218,739,700
1952	..	423,008	..	198,885,798
1953	..	494,365	..	271,078,715
1954	..	265,850	..	124,810,240

(iii) OIL PALM

42. Oil palm cultivation in Malaya is confined wholly to estates, but with organised central processing it could equally well become a smallholders' crop. New planting and conversion of areas under rubber to oil palms totalled 1,378* acres. At the end of 1954, of a total of 63 estates there were 52 in production, four more than a year ago.

43. Details of acreage planted and the production of oil and kernels are as follows:

Year		Planted Acreage		Palm Oil (Tons)		Palm Kernels (Tons)
1950	..	95,982	..	53,171	..	11,437
1951	..	97,377	..	48,274	..	11,771
1952	..	100,182	..	45,095	..	11,248
1953	..	108,265	..	49,098	..	12,669
1954	..	109,643*	..	53,950	..	14,471

44. The Ministry of Food in the United Kingdom, which had ceased bulk buying of palm oil in 1952, emerged as a heavy seller of oil towards the end of the first quarter of 1954. As a result, the confidence of the market was temporarily upset but prices rallied and the London quoted average price for 1954 at \$619.07 per ton was \$42.48 per ton higher than the 1953 price.

(iv) COCONUT

45. The coconut comes next in importance to rice and rubber as a smallholders' crop; only 19 per cent. of the estimated total acreage of 498,093* is estate planted. The coastal alluvial clays have proved eminently suitable for coconut growing and, where drainage and general husbandry are of a high standard, average yields of up to 1,600 lb. of copra per acre are not uncommon.

PRODUCTION (TONS)

(Federation of Malaya)

Year		COPRA			COCONUT OIL		COPRA CAKE
		Estates	Small- holdings				
1950	..	38,612	110,866	..	72,800	..	47,819
1951	..	39,422	120,620	..	86,397	..	55,661
1952	..	39,523	114,842	..	81,185	..	51,581
1953	..	40,130	111,666	..	79,459	..	50,422
1954	..	39,864	124,295	..	96,800	..	61,568

NET EXPORTS

(Pan-Malayan)

Year		COPRA			COCONUT OIL	
		Ton	Value \$		Ton	Value \$
1950	..	4,778	14,902,910	..	56,045	60,747,279
1951	..	10,878†	6,605,527	..	68,139	87,508,297
1952	..	27,821†	4,501,280†	..	65,113	53,965,806
1953	..	9,751†	2,084,752	..	60,779	58,033,294
1954	..	67,427†	23,446,381†	..	78,507	74,719,289

* Provisional. † Net imports.

46. Coconuts are planted in both pure and mixed stands, and while the production of copra for export or for local extraction of oil is the main market interest, nevertheless, there is a very considerable trade in fresh nuts for home consumption. Estate produced copra, the result of a carefully controlled process, is of high quality and generally commands a premium when sold. Smallholding copra, on the other hand, because it is seldom prepared in any other way than in crude kilns incapable of yielding a high grade product, is invariably of poor quality. But, because of a prevailing seller's market, the disposal of copra—no matter what quality—has been a comparatively easy matter for the average smallholder and the incentive therefore to improve quality and to grade before marketing scarcely exists.

47. Extensive drainage work on the west coast of Johore has considerably improved the long-term prospects for coconut cultivation in that area and upwards of 500 acres of known new planting by smallholders is reported.

48. The Rhinoceros Beetle, *Oryctes rhinoceros*, is Malaya's worst potential coconut pest whose incidence, despite widespread propaganda, is increasing. This is explained by the fact that the beetle has been found to breed extensively in felled rubber, and with rubber replanting now being conducted on such an extensive scale it is difficult to exercise the required amount of control to deny this breeding ground to the beetle.

(v) PINEAPPLE

49. Pineapples are grown throughout Malaya, but only in three States are they cultivated for the purposes of the canning trade. In the post-war rehabilitation of the industry, emphasis has been laid on permanent plantations in contrast to the catch-crop system of before the war. That a crop of such economic importance as the pineapple can be successfully grown on deep peat is indeed a fortunate coincidence and current policy therefore is to restrict sole cropping to the peat areas, of which there are large reserves.

50. The area under pineapples on both estates and smallholdings is steadily increasing. Large-scale preliminary clearing of jungle, extensive drainage works, and planting were in progress in Johore, Selangor and Perak.

51. The total acreage under cultivation at the end of 1954 and comparative figures for 1953 are as follows:

	1953			1954	
	Packers	Smallholders		Packers	Smallholders
Johore ..	7,900	6,873	..	8,526	8,459
Selangor ..	130	3,459	..	255	3,957
Perak ..	700	1,226	..	726	2,023
Others ..	—	3,642	..	—	4,003

52. The industry, through the Pineapple Joint Industrial Council, finances the annual programme of experiments which is pursued at the Pineapple Stations in Johore and Selangor by the Department of Agriculture. It is still considered that the stage has not yet been reached when a specialised research organisation divorced from the Department of Agriculture would be advisable.

53. The Johore 1954 crop, approximately double that of 1953, was estimated at 141,000,000 lb. with the ratio of estate to smallholding production being roughly 2:1. This greatly increased crop is accounted for partly by good weather and partly by improved husbandry, particularly as influenced by better drainage, extensive manuring and the use of copper sprays to counteract green die-back associated with a deficiency of that element.

54. Three meetings were held in 1954 between representatives of the packers and growers to negotiate agreements on fresh fruit prices of various grades. It is customary to equate the negotiated prices for fresh fruit with the ruling export price per case of canned fruit. At the end of the year, prices paid to growers were about 20 per cent. below those of 1953.

55. The two Johore factories packed a total of 577,739 cases, which represented an increase of 19 per cent. over the 1953 pack and 90 per cent. over that of 1952. Figures for exports of canned pineapple products from Malaya since 1950 are tabulated as follows:

EXPORTS				
Year		Tons		Value \$
1950	..	14,671	...	12,203,911
1951	..	16,913	..	16,884,112
1952	..	11,781	..	12,564,131
1953	..	17,368	..	19,002,707
1954	..	21,556	..	25,272,706

(vi) CACAO

56. Observation plots of Amelonado cacao established in all States and Settlements of the Federation continued to yield valuable information which, when studied in conjunction with the results from precise experimentation, has gone a long way towards improving the knowledge in regard to husbandry techniques for cacao under Malayan conditions. The prospects of cacao as a potential economic crop for Malaya are good and the progress so far achieved has been followed with keen interest in the country. For instance, several States, in pursuance of their land utilisation policy, have earmarked blocks of State land for future development with cacao. Recognition has also been given to the fact that the stage has been reached when planned development must receive full consideration, and a Cacao Working Party was constituted during the year to carry out such planning.

57. It can now be definitely stated that the surviving trees of the Trinitario cacao introduced into Malaya pre-war have little potential value from the point of view of a future industry, and a policy of cutting out such trees has, therefore, been advocated.

58. Commercial planting of Amelonado cacao, begun first of all in 1953 on an estate in Trengganu, was continued and at the end of 1954 140 acres had been established on that estate.

59. Shrews, rats and squirrels have all been troublesome, even on small, well-protected holdings, and it remains to be seen, once extensive planting is undertaken, whether or not pest control will prove excessively costly.

(vii) TEA

60. Both lowland and highland teas are grown commercially in Malaya and although the former may be of poorer quality, its greater yield per acre, almost double that for highland tea, more than offsets the disadvantages of a slightly lower market price. On well-managed highland estates crops of 800 lb. of made tea per acre are obtained. Tea is not exclusively an estate crop but smallholders appear not to attain the necessary standard of efficiency and consequently yields are low in comparison with estates. Clean weeding, despite publicity with regard to erosion dangers, is still practised by some growers.

61. Tea prices in 1954 were extremely good, causing the crop, temporarily at least, to be one of the most profitable to grow. Two lowland estates were extending their planted acreage. The anticipated increased incidence of Blister Blight (*Exobasidium vexans*) during the wet months of November and December was effectively controlled by the use of copper fungicides.

62. Production figures are as follows:

MADE-TEA				
Year		Production (lb.)		Exports of Local Tea* (lb.)
1950	..	3,317,930	...	2,435,938
1951	..	3,684,158	..	1,678,673
1952	..	3,785,158	..	1,752,157
1953	..	4,187,272	..	2,172,063
1954	..	4,590,330†	..	2,757,415

63. The following table gives, for 1954, statistics of acreage and production for highland and lowland estates:

		No. of Estates		Planted area (Acres)		Production made-tea (lb.)
Highland	..	29	..	4,721	..	1,938,453
Lowland	..	10	..	3,362	..	2,651,541

(viii) FOOD CROPS, VEGETABLES AND FRUITS

64. The acreage under food crops was substantially increased, 95,626 acres being planted as against 82,082 acres in 1953. This increase in the planted acreage was largely the result of three factors—the stabilisation of conditions in new villages, the large-scale acquisition of agricultural land for new villages, and extensive catch-cropping of areas under new and replanted rubber. The main rice substitute crops were sweet potatoes, tapioca and yams. Tapioca was also extensively grown for the export of starch, in which connection there were 39 factories in operation. During the annual fallow it is customary in the east coast States of Kelantan and Trengganu and in Kedah, Penang, Selangor and Malacca to cultivate small selected areas of the rice fields with crops of high cash value such as groundnuts, maize, beans, chilli, cucumber and lobak.

* In addition to these quantities, a small amount of Malayan tea is mixed with foreign teas and then exported.

† Provisional.

65. The considerable acreages of intensely cultivated market gardens which exist mainly for the production of leafy type vegetables—chiefly lettuce and mustard—were maintained, but cultivated acreages in Cameron Highlands, where cabbages are widely grown as a speciality crop, decreased by 15 per cent.

66. Water melons were an important seasonal crop in the northern States experiencing monsoon conditions.

67. Bananas were more and more favoured as a catch-crop in new and replanted rubber, the planted acreage showing an increase over that of 1953 of 7,876 acres.

68. Fruit trees in mixed stand are a feature of every kampong and the total area throughout the Federation is estimated at 91,000 acres. The Department's selected fruit clones are popular and the distribution of large quantities of improved planting material was an important Departmental undertaking.

69. The fruit harvest was generally well below average in most areas.

(ix) MANILA HEMP

70. On the experimental evidence so far available, the variety Tangongon would appear to be the best suited to Malayan conditions. Although satisfactory yields have been obtained on some volcanic soils and on well drained alluvial clays, no developments of any importance occurred in 1954.

(x) RAMIE

71. Cultivation is confined almost wholly to experimental planting. Trials have shown that the crop requires a high standard of cultivation and heavy manuring on most Malayan soils.

(xi) COFFEE

72. Coffee is essentially a smallholders' crop in Malaya and, on the present scale of cultivation, production is barely sufficient to meet local requirements. The average price for Liberica, the only planted variety of any importance, was between £400 and £450 per ton of dried beans, giving an estimated gross return per acre of anything from £100 to £150. The revival of interest in this crop is, therefore, understandable. Furthermore, future prospects appear good, since it is by no means certain that a slump in world prices would have a similar effect on internal prices in view of the fact that local demand, far from satisfied, is actually increasing. The planted acreage increased in 1954 to 10,557 acres.

(xii) SPICES

73. Only arecanuts and pepper are of importance as export crops. Others, such as chillies, ginger, turmeric, sirih, nutmegs and cloves, are all cultivated on a small scale exclusively for the internal markets.

(xiii) TOBACCO

74. Tobacco is an important cash crop usually grown in rotation with market garden vegetables, or as an off-season crop in padi areas. Though the leaf is coarse in quality it meets with a

ready sale for the manufacture of cut tobacco and cheroots. The acreage planted was estimated at 4,489 acres.

75. The Tobacco (Licensing) Ordinance, 1954, was passed on the 30th April, 1954, and permits an easy assessment of production and manufacture at any given time.

(xiv) MISCELLANEOUS CROPS

76. Other crops of minor importance grown were derris, gambier, kapok, ipecacuanha, patchouli, citronella, sugar palm, nipah palm, sago, groundnuts, maize, yams and pulses.

C.—STOCK

(i) CATTLE, BUFFALOES, GOATS AND SHEEP

77. Livestock, though an important capital asset in small-holding agriculture, are raised and maintained with the minimum of trouble to the owner. Mixed farming in the generally accepted sense is not practised. In the main padi-growing States, buffaloes and cattle are primarily used as draught animals, the production of meat and milk being of secondary importance. In certain States extensive areas are set aside as communal grazing grounds, but for the most part they are infrequently used and are not well maintained. Seldom, if ever, are concentrates fed. Milk production on a small scale is conducted by Indians in the vicinity of the larger towns.

78. Sheep are found in the drier east coast areas though not in large numbers. Goats are kept in most areas and their popularity is increasing.

(ii) PIGS

79. The prices of feeding stuffs remained high with the result that the average price of pork fell but little despite the substantial increase in the pig population. With the return to stable conditions in new villages pig production regained pre-Emergency level and the Federation once more became an exporter of pigs to Singapore. The use of Middle White boars for crossing with the local sows is now established practice in all the major pig-rearing areas.

(iii) POULTRY

80. A considerable trade continued to exist in poultry and eggs. There were large numbers of small-scale poultry rearers both in rural and urban areas whose needs in the way of pullets and eggs were met mainly by commercial poultry farms. These commercial poultry farms are highly organised units which rear both local and imported breeds. The Rhode Island Red remains the most popular of the imported breeds.

SECTION III

THE DEPARTMENT OF AGRICULTURE— ESTABLISHMENT AND STAFF

A.—ESTABLISHMENT

81. The establishment of the Department is shown in the chart at Table I. The number of posts for senior professional officers remained at 70. There were 14 vacant posts at the close of the year, made up as follows:

Agricultural Officers (including Agronomists) ...	8
Senior Lecturer, College of Agriculture ...	1
Senior Plant Pathologist ...	1
Senior Soils Chemist ...	1
Chemist ...	1
Botanist (Plant Breeder) ...	1
Canning Officer ...	1

B.—SENIOR STAFF CHANGES

(i) BRANCH HEAD POSTS

82. (a) *Head Office (Administration)*.—Mr. O. J. Voelcker, C.B.E., Director of Agriculture, proceeded on leave prior to retirement on the 21st December, 1954, and Mr. R. G. Heath, Deputy Director of Agriculture, was appointed to act as Director of Agriculture with effect from the 22nd December, 1954.

83. (b) *Field Branch*.—Mr. J. R. Curry, Chief Field Officer, was appointed to act as Deputy Director of Agriculture with effect from the 22nd December, 1954.

84. (c) *Education Branch*.—Mr. O. M. Lee, Principal, College of Agriculture, Malaya, resumed duty on the 5th January, 1954, on his return from leave.

(ii) RECRUITMENT

85. The following officers were recruited during the year:

- (1) Mr. A. V. Haddon, B.Sc. (Hons.), Dip. Agr. Sc. (Camb.), was appointed Botanist (Plant Breeder), Malayan Agricultural Service, with effect from the 28th June.
- (2) Dr. J. Dore, B.Sc. (Hons.), Ph.D., A.R.C.S., was appointed Botanist (Plant Physiologist), Malayan Agricultural Service, with effect from the 28th June.
- (3) Mr. M. G. Hawson, B.Sc. (Agri.), D.T.A., was appointed Agricultural Officer, Malayan Agricultural Service, with effect from the 2nd July.
- (4) Mr. G. F. Darnell, B.Sc. (Agri.), Dip. Agr. Sc. (Camb.), D.T.A., was appointed Agricultural Officer, Malayan Agricultural Service, with effect from the 5th August.
- (5) Mr. J. R. Dunsmore, B.A., D.T.A., was appointed Agricultural Officer, Malayan Agricultural Service, with effect from the 5th August.

TABLE I

DEPARTMENT OF AGRICULTURE, 1954

Organisation and Establishment by Branches (excluding Clerical and Non-technical Minor Posts)

DIRECTOR					
DEPUTY DIRECTOR					
RESEARCH BRANCH	AGRONOMY BRANCH	FIELD BRANCH	PUBLICATIONS BRANCH	EDUCATION BRANCH	ADMINISTRATION BRANCH
1 Chief Research Officer	1 Senior Agronomist	1 Chief Field Officer	1 Publications Officer	1 Principal, College of Agriculture	1 Administrative Officer
5 Heads of Divisions : Senior Botanist Senior Chemist Senior Soils Chemist Senior Entomologist Senior Plant Pathologist	13 Other Senior Officers 4 Senior Officers other than Professional 1 Assistant Statistician 15 Agricultural Assistant Service Scheme	1 Personal Assistant 6 Senior Agricultural Officers 11 Agricultural Officers 1 Agricultural Economist	2 Senior Lecturers 1 Registrar and Bursar	1 Office Assistant 1 Financial Assistant	1 Horticultural Officer, Penang
14 Other Senior Officers 5 Senior Officers (<i>Leave Reserve</i>) 1 Assistant Chemist 17 Agricultural Assistant Service Scheme	27 Junior Agricultural Assistant Service Scheme 8 Miscellaneous Junior Technical Posts	7 Senior Officers (<i>Leave Reserve</i>) 103 Agricultural Assistant Service Scheme 171 Junior Agricultural Assistant Service Scheme	9 Agricultural Assistant Service Scheme	1 Horticultural Assistant	
32 Junior Agricultural Assistant Service Scheme 19 Miscellaneous Junior Technical Posts	69 Posts	301 Posts	3 Miscellaneous Junior Technical Posts	15 Posts	3 Posts
			4 Posts		2 Posts

(6) Mr. M. J. Smith, B.Sc. (Hort.), D.T.A., was appointed Agricultural Officer, Malayan Agricultural Service, with effect from the 5th August.

(7) Mr. M. J. Strickland, M.A., D.T.A., was appointed Agricultural Officer, Malayan Agricultural Service, with effect from the 5th August.

(iii) RESIGNATION

86. Mr. E. A. Rosenquist, Botanist, resigned from Government Service with effect from the 27th July, 1954.

(iv) RETIREMENT

87. Mr. Gunn Lay Teik, O.B.E., M.A., Senior Chemist, who was re-employed with effect from the 1st January, 1952, retired on the 1st April, 1954.

(v) PROMOTIONS

88. Mr. A. E. Billington, Canning Officer, was promoted to the post of Senior Chemist with effect from the 1st April, 1954.

89. The following officers, who proceeded overseas for training to equip them for promotion to posts in Division I, returned to Malaya in 1954:

Che Mohd. Noor bin Wahab, B.Sc. (Agri.), was promoted Pupil Agricultural Officer with effect from the 23rd August.

Che Ahmad bin Mohd. Amin, B.Sc. (Agri.), was promoted Pupil Agricultural Officer with effect from the 12th September.

Mr. Van Thean Kee, B.Sc. (Hons.), was promoted Pupil Botanist with effect from the 12th September.

(vi) TECHNICAL ASSISTANCE, COLOMBO PLAN

90. During the year, a further two Colombo Plan Technical Officers arrived in Malaya for a period of two years; they were:

(1) Mr. R. G. Lockard, B.S.A., M.Sc. (Agri.), who arrived in Malaya on the 17th April, 1954, and was posted to the Botany Division, Research Branch, Kuala Lumpur, and

(2) Mr. A. P. Edwards, B.S.A., B.A., M.Sc., who arrived in Malaya on the 8th March, 1954, and was posted to Kedah as an Agronomist.

91. Two technical officers under the Colombo Plan relinquished their term of office in Malaya to return to Canada; they were:

(1) Dr. W. J. Cherewick, who left Malaya on the 11th August, 1954, and

(2) Mr. A. P. Edwards, who left Malaya on the 15th August, 1954.

SECTION IV

WORK OF THE DEPARTMENT OF AGRICULTURE

A.—RESEARCH AND INVESTIGATION

1.—PADI (RICE)

(i) VARIETY SURVEY AND SELECTION

92. Padi varietal improvement work is still primarily concerned with increase in yield, and this is being achieved through:

- (a) comparative yield trials of local and redistributed varieties of primary importance with a view to their more extended and efficient use;
- (b) improvement of indigenous varieties of primary importance by pure line selection;
- (c) study of local varieties of secondary importance and study of exotic varieties with a view to their commercial exploitation or use in hybridisation;
- (d) selection in hybrid populations;
- (e) quality assessment, relative to selection and distribution of improved strains; and
- (f) ancillary investigations.

93. When work on padi was recommenced in 1946, and during the next few years, the order of importance assigned to these six broad aspects of work was that in which they are set out above. In the natural course of events over the past eight years, most of the major indigenous varieties have now been tested in the ecological areas to which they are likely to be adapted, and work on pure line selection in a number of the major varieties is well advanced. During the past two years, and in this last year in particular, there has therefore been a marked shift in emphasis of the relative importance of these undertakings. Field trials of indigenous varieties have been in many areas superseded by trials of new, pure lines forthcoming from selection work; and hybrid populations now constitute the bulk of the material under selection. In the course of the next few years it is expected that the original order of importance of these six aspects of padi improvement will be largely reversed.

94. (a) *Variety Trials*.—The general programme of field trials of established varieties is approaching completion in most padi areas. Such trials will only be undertaken in the future in special cases, to which reference is made later. During 1953-54, 40 varietal field trials have been completed, including 18 trials of unselected varieties. Statistical analysis of most of them has been completed, but owing to pressure of other work it has not yet been possible to examine the results in sufficient detail for final report. Conclusions on these completed trials have been suggested for immediate guidance and must be regarded therefore as tentative.

95. During the past year, six new trials involving established medium and long term varieties have been commenced. These are:

- (i) at Rantau Panjau and Pulai Padi Test Stations in South Kedah, and at Bukit Merah Padi Experiment Station in Province Wellesley, testing six Kedah varieties

and selections for suitability for the South Kedah, North and Central Province Wellesley region;

- (ii) at Kota Bharu Padi Experiment Station, testing the suitability of eleven West Coast medium term varieties to Kelantan conditions;
- (iii) at Pasir Mas Padi Test Station, Kelantan, comparing seven Kelantan and five West Coast medium term varieties, and
- (iv) at Pasir Puteh Padi Test Station, testing five West Coast medium term varieties in the lighter, sandy, Kelantan soil.

96. In addition, there are in progress 20 sets of varietal observation plots serving the following purposes, seven of which were newly commenced this season:

- (i) Observation of indigenous varieties preliminary to laying down varietal trials;
- (ii) Observation of newly introduced exotic varieties from East Africa, Borneo, Saigon, Sarawak, and short term Indonesian varieties; and
- (iii) Observation of new pure line selections to test their general suitability to new areas, i.e.
 - (a) Serendah Kuning selections at Temerloh, Pahang;
 - (b) Mayang Sa-Batil selections at Titi Serong, Perak.

97. (b) *Early Varieties*.—The foregoing paragraphs deal essentially with varieties of medium (180 day), or longer, maturation periods. In addition to these, there is an increasing demand for short term varieties which will mature in 100 to 150 days from sowing. Such varieties are normally grown in some of the more extensive padi areas of Kedah, Kelantan and Trengganu to furnish an early food supply before the main crop matures. Comparative trial and selection is in progress with some of these varieties in Kedah but improvement of the Kelantan varieties of *padi menghulu** has not yet started.

98. Other special problems susceptible of solution by development of suitable short term varieties are under investigation. These include varieties for growing in areas such as central Province Wellesley, where acreage under double cropping has expanded, and for cultivation in the riverine areas of Pahang and parts of north Johore as a means of avoiding seasonal flood damage which is regular and serious in these areas.

99. Indigenous short term varieties, particularly non-photo-period-sensitive varieties suitable for off-season cultivation, are very few in number. Such varieties are being actively sought in local populations and those already available are included in trials in the areas mentioned above. In addition, newly discovered indigenous early varieties as well as foreign introductions have been under observation in unreplicated plots at various padi stations for the past season or two. Success with trials of such varieties has so far not been conspicuous, largely as a result of the technical

* *Padi menghulu*=the early maturing padi crop grown in Kelantan on low-lying river flats with fertile soil, where deep flooding occurs during the monsoon necessitating early harvest.

difficulty of protecting them from abnormal pest and climatic damage when they are grown in areas primarily planted to medium term varieties. The performance of these varieties over the past few years is being reviewed, and a co-ordinated plan for their further testing will be devised.

100. Trials of local Malayan, Thailand and Formosan (*japonica*) short term varieties were concluded during the year in Padi Test Stations at Kepala Batas and Rantau Panjang in Kedah, at Bukit Merah in Province Wellesley, and at Ulu Klawang, Ampang Tinggi and Kendong in Negri Sembilan.

101. Other short term variety trials are in progress at Kepala Batas, Kedah, for early season cropping, and in Padi Test Stations at Temerloh, Kerdau and Dong in Pahang in investigations on avoidance of floods. One new trial was commenced at Bukit Merah, Province Wellesley, in a search for suitable varieties for double cropping.

102. The best of the local Malayan varieties are Radin Kling, Radin Goi, Serendah Menangkebau, Acheh Puteh and Seriab, but none of these is suitable for off-season cultivation, being either inhibited from flowering by the relatively long off-season daily photoperiod (season fixed) or of too long maturation period to fit in with a double-cropping system.

103. Of the Formosan (*japonica*) varieties which can be grown in the off-season (February to June), B.M.5, Pe Bi Fun, Go Chi Sai, and Sa-Chupak appear to be the best, but their sticky *japonica* type rice is not popular, and these varieties are most unlikely to provide the final solution.

104. Observation plots at Dong, Pahang, of imported short term Indonesian varieties were discontinued pending the inclusion of these varieties in replicated trials. Observation plots have been planted at Kahang in Johore.

105. (c) *Variety Survey*.—The five collections of indigenous varieties have been maintained and a few additions made. The number of varieties in each collection is at present—

(a) Short term varieties:

Pulau Gadong Padi Experiment Station, Malacca	...	...	...	...	...	45
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(b) Medium term varieties:

Pulau Gadong Padi Experiment Station, Malacca	...	...	...	...	...	430
Telok Chengai Padi Experiment Station, Kedah	...	...	...	...	...	200
Kota Bharu Padi Experiment Station, Kelantan	...	...	...	...	...	310

(c) Long term varieties:

Titi Serong Padi Experiment Station, Perak	...	...	...	...	...	150
Jelawat Padi Experiment Station, Kelan- tan	...	...	...	...	...	49

Total	...	1,184
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Preliminary collections of Pahang and Trengganu varieties are being built up at stations in those States.

106. The 850 or so lesser known varieties in these collections have been under observation over periods up to seven years and, as was expected, few high yielding strains have been found. Several promising varieties from the Kota Bharu collection have been included in variety trials in Kelantan.

107. Increased attention is therefore being given to the variety collections as a source of parental material for future hybridisation work. During the past year, however, owing to lack of staff and pressure of other work, little attention, beyond their maintenance, has been given to these collections.

108. (d) *Trials of Former Ear-Row Pedigree Selections.*—Six final trials of pure line selections, on which work was commenced in Kedah some 15 years ago, were completed during the year. Of these, the most interesting result was obtained with the variety Mayang Pasir at Sala Kanan Padi Test Station where Mayang Pasir 28 significantly out-yielded the standard variety Mayang Ebos 80 by 8 per cent.

109. Similar trials are still in progress with selections of the varieties Subang Intan at Hutan Kampong Padi Test Station and Mayang Pasir, Haji Haroun and Radin Goi at Telok Chengai Padi Experiment Station. Both Stations are in Kedah.

110. (e) *Variety Selection.*—Pure line selection within 14 major varieties has been continued and is approaching completion in two of these varieties. One new selection project, with the short term variety Radin Kling, has been under investigation in the past year.

111. Stocks of selected strains of Nachin, Siam, Serendah Kuning, Radin Ebos, Mayang Sa-Batil and Seraup totalling 267 pure lines have been maintained un-reduced in numbers pending final variety trials.

112. Varieties in earlier stages of ear-row selections are as follows:

State	Variety			No. of Selections
Selangor	Acheh	Puteh	.. ..	138
Kelantan	Anak	Naga	.. ..	100
Kelantan	Mayang	Sa-Gumpal	.. ..	811
Perak	Seri	Raja	.. ..	1,395
Penang and Province Wellesley	Kontor	.. ..	.. ..	1,000
Perak	Machang	.. ..	.. ..	1,000
Negri Sembilan	Serendah	Puteh	.. ..	1,506
Kedah	Radin	Kling	.. ..	Foundation Stock

113. The position as regards the six more advanced selection projects is—

(A) *Serendah Kuning in Negri Sembilan*

Forty-eight selected lines are being maintained and final selection trials of the most promising 12 of these strains are now in their third year at the three stations in Negri Sembilan. Progress of these trials has so far been satisfactory and they should be

completed in the current season. This should enable seed multiplication to be undertaken in 1955 and seed distribution to commence with confidence in 1956.

114. This project has, however, been used to explore methods of curtailing selection time without serious loss of efficiency and, as a result, selection of the same material is at present in progress at three distinct stages. The stage outlined in the preceding paragraph represents what may be described as the first accelerated phase.

115. The normal phase, in which selections undergo more thorough examination in replicated ear-rows before inclusion in field trials, is still in progress and will necessitate the current series of final selection trials being followed up by a second series. This should commence in 1955.

(B) Nachin in Malacca

116. Selection of this variety is being carried out at one station only, Pulau Gadong Padi Experiment Station, and a stock of 42 selections is being maintained. Some of these strains promise to be high yielding, but little success has been achieved in improving resistance to lodging.

117. From previous records, one selection, N. 5057, promises to be an outstanding yielder. Results of final trials have therefore been anticipated and this strain is now being tested in a regional trial throughout the areas of Malacca to which it is likely to be adapted. Seed multiplication is proceeding simultaneously and, if this trial proves successful, seed distribution of this variety will thereby be advanced by a year.

118. As this variety is adaptable and able to give satisfactory yields under adverse conditions and on the poorer soils, the new selections have already been subject to preliminary trial in other areas.

(C) Siam in Malacca

119. The purpose of this project is to improve yield and lodging resistance in high quality, long grain, Siam type varieties. Selection, so far, has been based on yield and straw strength. Quality assessment had to be deferred owing to lack of staff and equipment. Forty lines are being maintained. In 1954, these selections were in their final ear-row stage and it is proposed to commence field selection trials in the coming year with as many selections as can be handled. Present records suggest that there are a number of selections with stronger straw and which are capable of out-yielding the standard variety Siam 29.

(D) Mayang Sa-Batil in Penang

120. Selection is in progress at Genting Padi Test Station where 40 strains are being maintained.

121. Meanwhile, interest in this variety has increased in North Krian, and selection was commenced in 1952 on 60 lines transferred from Genting Padi Test Station to Titi Serong Padi Experiment Station, Perak. Although ear row selection is still

incomplete, field selection trials were commenced at Padi Test Stations at Genting in Penang, Sungei Acheh in Province Wellesley, and Titi Serong, Kuala Kurau and Briah in Perak, with the same 12 lines.

(E) *Seraup Kechil at Titi Serong Padi Experiment Station, Perak*

122. Forty-five selections are being maintained and final selection trials should commence in 1955. There are a number of strains which promise to out-yield the standard variety S.K. 48. Owing to pressure of other work it has not been possible to commence exploratory yield trials or trial of these selections in other areas.

(F) *Radin Ebos at Telok Chengai Padi Experiment Station, Kedah*

123. Fifty strains are being maintained under selection in ear rows, and several of these promise to out-yield M.E. 80 and R.C. 4.

124. As in the case of Mayang Sa-Batil selection at Titi Serong, an attempt is being made to accelerate selection, and a trial (P. 296) of 47 selections, with Radin China 4 and Mayang Ebos 80 as controls, using 1/360 acre plots, was commenced at Telok Chengai during the 1954-55 season.

125. (f) *Mass Selection*.—Mass selection has been carried out concurrently with ear row selection on the varieties Serendah Kuning, Nachin, Mayang Sa-Batil, Radin Ebos, and Seraup Kechil, and these stocks are included in final selection trials for comparison with the pedigree lines and the unselected variety. So far as these trials have progressed, mass selected material has proved little if any better in yield than the unselected stock.

126. In the past two years, sample individual plant selections have been made from the mass selected material and are being compared for yield with pedigree ear row selections. While these comparisons are still incomplete, there are indications that some of these pure lines ex-mass selection may yield as well as the better ear row pedigree lines.

(ii) QUALITY ASSESSMENT

127. *Varietal, Milling and Cooking Qualities*.—The estimation of the imbibition (water absorption) and cooking quality of rice of different varieties was resumed, and during the latter part of the year a commencement was made in estimating the milling quality of different varieties of padi. Owing to lack of staff and equipment, little has hitherto been done in this direction, though it is of fundamental importance to the acceptability of improved strains in many rice areas of Malaya.

(iii) HYBRIDISATION

128. Two groups of hybrid populations are under selection. In both cases crossing was commenced in 1950 and the most advanced material planted in 1954 is in the F_4 generation. New crosses have not been made during the past two years nor can this work be undertaken until existing selection stocks are considerably reduced in volume and land is made available.

129. (a) *Indica* × *Japonica Hybrids*.—Fertility in the F_2 generations ranged from 100 per cent. to a few sterile ears per plant, but few completely sterile plants were found, and none at Telok Chengai, Kedah. Variation in fertility was of similar order in most families.

130. Microsporocytes of plants, representing 20 families which exhibited sterility, were examined meiotically at stages from metaphase I to anaphase II. In all these families, chromosome number and behaviour at both divisions was essentially normal. Pollen tetrads and variability in pollen size was also normal. Only a few cells exhibited bivalents with delayed separation and “lagging” chromosomes. An anaphase bridge was found in one cell. Chromosome irregularity was therefore inadequate to account for the sterility found in this material and it must be assumed that the cause is primarily genic.

131. Selection objectives are, primarily, improved vigour and yield, and short maturation period. But attention is also being given to tillering, lodging, shattering, absence of awns and response to fertilisers. That considerable progress is being made in selection is clearly apparent from comparison in the field of F_2 , F_3 and F_4 material. Whether or not it will prove possible to make direct commercial use of this material cannot yet be foreseen, but it has provided a stock of genes not found in local varieties and, by backcrossing and possibly outcrossing to other varieties, will hasten the breeding of much needed short term varieties.

132. (b) *Hybrids of Local Varieties*.—From crosses carried out in 1950 and 1951 with a view to combining high yield, strong straw, prolific tillering, adaptability, rice quality and shorter maturation period, F_3 and F_4 material is now being handled. As with the hybrid material from Cuttack, India, as many progenies as possible are being selected at the Padi Experiment Stations at Pulau Gadong, Malacca, and Telok Chengai, Kedah, in both progeny plots and ear-rows. Altogether, 53 crosses of 16 varieties in various combinations are being selected.

133. (c) F_3 *Generation*.—Forty-four progenies are being grown in progeny plots at both the above Experiment Stations together with 2,828 pedigree ear rows at Telok Chengai, and 1,613 at Pulau Gadong.

134. (d) F_4 *Generation*.—Nine families are being grown in progeny plots and 742 pedigree ear rows at Pulau Gadong and 862 at Telok Chengai. Unpromising lines have been discarded and new single plant selections from the F_3 progeny plots have been added.

135. All this material, even many F_4 's, is still actively segregating and it is too early to forecast results. In spite of the close relationship of many of the parents used, there is evidence of hybrid vigour in several families and a good expectation of selecting vigorous, heavy yielding strains. Owing to the volume of material being handled by a limited staff, it has not been possible to record comparable family yield data as a basis for selections; it is hoped to do this in the current crop.

136. Variation in resistance to lodging appears to be sufficient in some families, even in hybrids between susceptible parents, to offer opportunity for isolating resistant strains. In the F_3 generation the family L.H. 5001 (Siam 29 $\times$ Radin Siak 34) was almost 100 per cent. lodged. A few of the plants, those apparently least affected, were retained and their progeny this season so far show little lodging.

(iv) NATURAL CROSS POLLINATION

137. Information on the degree of natural cross pollination normally occurring is essential in devising an efficient ear row selection technique. Work in this connection, commenced in 1948, has been in abeyance pending production of homozygous test varieties. These have now been obtained and work has been resumed in the current season at Pulau Gadong Padi Experiment Station, Malacca.

138. In the absence of any precise knowledge of the genetics of Malayan varieties, the procedure adopted is to interplant pigmented, glutinous, awned and similar varieties with others lacking these characters and estimate crossing by checking segregation in the progenies of the latter. Results should be obtained in two years' time.

(v) PHOTOPERIODISM

139. *Variety Sensitivity*.—These investigations were commenced some years ago to assist in selecting non-photoperiod-sensitive varieties for out-of-season planting, to determine the optimum planting time for photoperiod-sensitive varieties and to furnish fundamental information on varietal photoperiod-sensitivity necessary to the improvement of agronomic practice. In the absence of the necessary specialised equipment, methods have hitherto been largely empirical.

140. Earlier investigations, attempting to relate yield to planting date, largely failed owing to the differential pest and other damage usual with out-of-season cropping of small areas. To overcome this, field cages have been made available in the past two years at Kota Bharu, Kelantan, Temerloh, Pahang, and Pulau Gadong, Malacca, and the cage at Kuala Lumpur for pot experiments has been reconstructed.

141. Field experiments have been laid down at Pulau Gadong to determine photoperiod-sensitivity of a range of varieties by monthly plantings throughout the year. Floods in December destroyed a few varieties in one or two treatments but the damage was insufficient to disrupt work seriously. Similar experiments have been completed at Kota Bharu.

142. It is proposed to commence a further experiment in the coming off-season at Pulau Gadong with representative *indica* $\times$ *japonica* hybrids as a guide to selection of suitable material for out-of-season cropping.

143. The first of the experiments completed in 1954 at Kota Bharu suggests that maximum yield is obtained at a maturation period 20 to 25 per cent. greater than the minimum.

(vi) STUDIES OF NUTRIENT REQUIREMENTS

144. (a) *Mineral Uptake of the Padi Plant*.—The results of an initial study of the mineral uptake of padi plants from transplanting to harvest in six plots of unmanured padi (Siam 29) at Sungei Burong, Selangor, proved of considerable interest, and the study was continued in greater detail with the variety Serendah Kuning 11, in a replicated NPK factorial manurial experiment at Kuala Klawang Padi Station, Negri Sembilan, during the 1954-55 season. This work is still in progress.

145. The extension of this study has been directed towards the analyses of padi from other manurial experiments. The initial study had shown that the best time for analyses, i.e., when the concentration of nutrients is highest, is approximately eight weeks after transplanting; consequently, samples of this age have been taken from three 3³ NPK factorial experiments in different areas. All plots were sampled along V transects. A second series of samples was also taken, from a number of the plots, along single diagonal transects for a statistical comparison of the variation given by these two different sampling techniques.

146. (b) *Deficiency Symptoms in Sand Cultures*.—An investigation has been commenced to study and identify symptoms of deficiency of calcium, magnesium, nitrogen, phosphorus and potash in padi, to facilitate field diagnosis. The variety SM. 29 was grown in sand cultures with nutrient solutions lacking each of four elements or containing them at 1/3 normal concentration: for nitrogen 1/10 and 1/2 normal concentrations were used. A complete nutrient control was also grown.

147. Deficiencies have been classified as severe or mild as, in some cases, the symptoms at the two concentrations differed. Reduction of nutrients to 1/3 had little effect on plant weight but reduced grain yield.

148. It is of interest to note that the reduced supply of potash and phosphorus delayed flowering five to ten days whereas reduced nitrogen supply accelerated it by seven days. These studies are continuing and this experiment will be repeated with other varieties as there is evidence that the same deficiencies may cause different symptoms in different varieties.

149. (c) *Penyakit Merah*.—Further field and laboratory studies of *penyakit merah* (red sickness) of padi have confirmed that it is not normally caused by any parasitic organism. This abnormal and unhealthy condition of growth is not usually a serious affliction of padi, but it occurs widely, and appears to be a complex of acute nutritional deficiency symptoms brought about in sub-optimum soil by adverse conditions, possibly including high acidity or poor drainage, either of which may interfere with nutrient availability or uptake.

150. Experiments have been directed towards discovering whether the symptoms are connected with deficiencies of any of the major or minor nutrients. In pot tests, using soil from 16 different areas where *penyakit merah* had occurred, phosphate had by far the most marked effect in improving the growth of the

plants; nitrogen had a lesser beneficial effect, but the addition of potash, lime or minor elements had no effect. Field tests, in which the same major and minor nutrients were applied to affected padi plants, were inconclusive.

151. In view of the possibility of aluminium toxicity and the precipitation of iron and phosphorus in the roots of the padi plant, root sample analyses would be of interest, but no convenient method has yet been found for washing the roots of the padi plant so that they are entirely free of soil.

152. As evidence of mineral deficiencies and of sub-optimal soil conditions, *penyakit merah* of padi provides a useful line of research on padi soil fertility problems, and a small Committee has now been formed to co-ordinate investigations, both laboratory and field.

(vii) INSECT PESTS

153. (a) *Stem Borers*.—A number of experiments in the control of stem borers with chemical insecticides were carried out but, owing to the toxic effect on fish and ducks, these insecticides cannot be regarded as practical means of control.

154. Further observations were made on the incidence of and damage done by stem borers with a view to planning full scale investigations, and it has now been decided to station an Entomologist in Krian for full time research on stem borers of padi, to commence before the next padi season. The programme of research will include (a) surveys of distribution, (b) estimation of borer damage, (c) ecological studies, including off-season hosts, (d) means of control—chemical, biological, etc.

155. (b) *Leptocorisa acuta* (*Rice Bugs*; Malay=Pianggang or Kesing).—This is probably the second most serious pest of padi, sucking the young grain in the “milk” stage. Various methods of control by collection with sticky nets, ropes and light-traps, and occasionally by small scale insecticidal dustings, have achieved little success in control. It is intended to try “fogging” treatments over wide areas of padi fields when suitable power equipment is available.

(viii) DISEASES

156. *Seed Treatment*.—Tests were begun during the year to discover whether treatment of padi seed with a fungicide would be advantageous. In *in vitro* tests, surface sterilisation with 0.1 per cent. mercuric chloride solution in water reduced the percentage of seed contaminated by micro-organisms from 55 to 38 (average of 32 tests). Pot tests, using an organic mercurial seed dressing, showed that percentage germination could be increased by its use [from 82 to 89 per cent. (average of 25 tests)]: more important, however, was the decrease in the percentage of diseased seedlings from 21 to 2 per cent. (average of 25 tests). A preliminary field test indicated that seedlings produced from treated seed made better and more even growth in the nursery than those from untreated seed.

157. In pot experiments designed to discover the most effective method of seed treatment, three organic mercurial seed dressings (two dusts and one liquid) and one dressing based on TMTD* (an organic non-mercurial fungicide) were tested. All mercurials gave improved germination: TMTD was rather less effective. These experiments are being continued.

158. Work is proceeding on the isolation, identification and pathogenicity testing of the fungus flora of padi seeds.

2.—OIL PALM

(i) BREEDING AND SELECTION

159. (a) *Dumpy Palm*.—Yield of dumpy palms at the Federal Experiment Station, Serdang, continues to compare favourably with that of tall palms, as the following figures show:

Field		Palm		Bunch Yield (tons per acre)		Oil Yield at 15 per cent. Extraction (tons per acre)
4	..	Tall	..	5.8	..	0.87
3a	..	Dumpy	..	6.6	..	0.99

160. There are at present 13 progeny trials of dumpy origin established on estates. Five of these are observation blocks of unreplicated, pedigree, dumpy progenies. Six of the other eight are replicated lay-outs. Four are trials with pedigree dumpy crosses, two with dumpy $\times$ tall progenies backcrossed to dumpy, one comparing dumpy and tall progenies, and one using dumpy-*pisifera* crosses. Several of these trials are now beginning to fruit, and yield records on two of them will be commenced early in 1955.

161. (b) *Normal Tall Palms*.—The selfed progeny lines of tall palms at the Federal Experiment Station, Serdang, are much more variable in yield and other genetic characters than are the dumpy families, but also contain material of much interest for development if land and funds could be made available.

162. (c) *Pisifera and Tenera Material*.—Exchange of pollen and seed in connection with a co-operative breeding programme with institutes in West Africa was concluded during the year.

163. Much of the pedigree *pisifera* pollen imported from Africa arrived in a condition of low viability and set of seed has been disappointing. Evidently further information on packing and transport of oil palm pollen is required.

(ii) PROCESSING

164. *Oil Palm Kernel Extraction*.—The general practice of improved steam sterilisation of oil palm fruit bunches has resulted in better quality and higher extraction of pericarp oil, but has affected the quality of the kernels. The relatively mild heat reaching the kernels may cause greater activity of kernel enzymes, resulting in rapid development of acidity. Experiments have now been commenced to evolve an improved method of palm kernel

* TMTD = tetra-methylthiuram-disulphide.

extraction and drying to give improved stability of palm kernels, and higher quality palm kernel oil.

(iii) OIL PALM LEAF BRONZING

165. Series of chemical analyses, continued for several years, of samples from the third and the 17th fronds of healthy and "bronzed" oil palms at the Federal Experiment Station, Serdang, were completed early in the year. From work in West Africa, it is now recognised that the "bronzed" condition of fronds is compounded of two mineral deficiency symptoms—"yellowing" and "orange spotting". All the data from these chemical analyses have been examined, therefore, particularly in respect of correlations of potash, manganese and magnesium deficiencies with "orange spotting" and "yellowing". A report has been prepared for publication.

(iv) DISEASES

166. Leaf blight of young oil palm seedlings, caused by *Colletotrichum* sp., was reported. Previous reports have been concerned with blights caused by *Curvularia* sp., and *Helminthosporium* sp. They are not, however, of common occurrence, and there is some possibility that they may be correlated with potash or other soil mineral deficiency.

(v) "CROWN DISEASE"

167. A number of reports of bent fronds of young oil palms were received during 1954, and in several instances reference was made to "crown disease". The malformed, young fronds are usually very much bent, with portions of the midrib quite bare of leaflets; in addition, small pieces of broken and decayed leaflets are usually present adhering to the young fronds, so that a fungus disease was first suspected. In each case, however, mechanical injury of some sort has been recognised; no parasitic fungus has ever been found associated with "crown disease". The most usual cause of the bent fronds is damage to the young shoot by rhinoceros beetle (*Oryctes rhinoceros*). Other forms of mechanical injury recognised included falling fronds from old palms and rat damage. On one estate, bent fronds, just after transplanting, were evidently due to severe friction between fronds during transport, but usually the damage occurs long before the bent fronds are conspicuous, and causes are not readily recognised.

(vi) INSECT PESTS

168. *Bagworms*.—Partial defoliation of oil palms by bagworms of *Cremastopsyche pendula* Joannis over about 2,000 acres was reported from an estate in South Perak. Seven hymenopterous parasites were eventually bred from the bagworms and there was also some control by the predatory beetle *Callimerus arcuifer* Chap. These parasites and predators were, however, not achieving full control of the pest, and the use of lead arsenate dust was recommended. This did not adhere well to the foliage, and dusting on to wet fronds was then tried. Calcium arsenate dust was subsequently used as it adhered better to the fronds, but the beneficial control effects have not yet been proved.

3.—COCONUT

(i) SELECTION AND BREEDING

169. Steps have been taken to recommence work on the selection of improved coconut material and to salvage the selected material from the former experiment station near Port Swettenham, Selangor.

170. Harvesting commenced in June, and by the end of the year 567 nuts had been reaped from 23 of these palms and 194 had germinated. It is proposed to transplant them in due course at the new station for coconut work which is being opened at Telok Bharu in South Perak. Here they will be used for progeny testing, seed production and as a foundation stock for further selection and breeding.

171. In anticipation of commencement of controlled breeding work on coconuts, observations are being carried out on flowering habit of dwarf, semi-dwarf and tall palms and trial pollinations are being made.

(ii) INSECT PESTS

172. (a) *Oryctes rhinoceros*.—A survey of the costs of control of the rhinoceros beetle *Oryctes rhinoceros* has been made with a view to assessing the possible value of measures for its biological control by the Zanzibar wasp, *Scolia ruficornis*. Staff shortage and financial stringency, however, have necessitated postponement of further action.

173. Meanwhile, experiments are being designed for examining ways and means of rapid destruction of palm and tree stumps, which provide the normal breeding sites for this pest.

174. (b) *Artona*.—A brief study of extent and development of pupal parasitism of *Artona catoxantha* by the Tachinid fly, *Ptychomyia remota* Ald., was made towards the end of the year when an outbreak occurred on an estate in Province Wellesley. The percentage parasitism was 40 in September and rose to 51 early in December, but the full effects of parasitism and the effect of rain and wind on movement and suppression of this pest have yet to be studied.

4.—PINEAPPLE

(i) SELECTION AND BREEDING

175. Selection stocks of local Singapore Spanish, Sarawak and imported Smooth Cayenne varieties have been maintained at the experiment station at Jalan Kebun in Selangor. This material consists of 2,835 Singapore Spanish clones varying in size from one to nine plants, a bulked plot of 603 individual Sarawak plants, and 25 plants of Smooth Cayenne imported from South Africa.

176. *Singapore Spanish*.—Harvesting of the first crop from the Singapore Spanish material was nearing completion at the end of the year but a further crop will be taken before selection is commenced. Marked differences in growth habit and vigour between clones are discernable; records of fruit harvested have not yet been analysed.

177. This material is being duplicated at Alor Bukit Experiment Station in Johore, to which Station slips of each clone are being transferred as the fruit is harvested at Jalan Kebun. Some 10,000 slips of 1,654 clones had been transferred by the end of the year. When all clones have been duplicated in the selection area in Johore, it is proposed to replant stocks at Jalan Kebun and bulk up clones at present represented by too few plants for effective selection.

(ii) CHEMICAL ANALYSES

178. Chemical analyses have been continued on ripe pineapples with the following objectives:

- (i) establishment of normal values for chemical composition;
- (ii) correlation of sugar/acid composition of fruits with concentrations of potassium, phosphorus and other major nutrient elements; and
- (iii) assessment of effects of manurial treatments on the structure of fruits.

179. In one series of these analyses, ripe fruits have been obtained from an experiment at the Federal Experiment Station, Jalan Kebun, where five levels of potash treatment were tested with pineapples growing on peat. An indication of the better quality fruit obtained with potash manuring may be seen in brief summary as follows:

Variety: Singapore Red Spanish

Treatment		Mean Sugars per cent.		Titrateable Acidity (per cent. citric)		pH		Total Ash (per cent.) Wet Basis		K ₂ O in Ash per cent.
200 lb. K ₂ O per acre per annum	..	13.5	..	0.75	..	3.73	..	0.39	..	58.8
50 lb. K ₂ O per acre per annum	..	11.3	..	0.71	..	3.90	..	0.35	..	36.7
Control	..	10.15	..	0.49	..	4.27	..	0.36	..	29.4

(iii) CANNING RESEARCH

180. In the absence of a full time Canning Officer, canning research has been carried on at Headquarters, and the small staff at the Canning Research Station, Johore Bahru, has been engaged on routine examination and canning of fruit from the Alor Bukit experiments.

181. The Station staff co-operated with the Lee Pineapple Company in carrying out large scale trials with regard to the results of canning stale fruit. This work is still proceeding. It is hoped to demonstrate conclusively the effects of staleness of fruits which have suffered from delays in handling before processing.

(iv) INSECT PESTS

182. Studies on mealy-bug wilt associated with *Dysmicoccus brevipes* (Ckll.) showed that the insects leave the plants as soon as wilt symptoms appear.

183. Artificial inoculation of Sarawak pineapple with *Dysmicoccus* resulted in obvious wilt, the fruit being only half the weight, stunted, sour and delayed in growth some 2½ months, compared with normal uninoculated plants.

184. A randomised plot experiment was set up in December to study the inter-relations between presence of the mealy-bugs and the wilt.

(v) DISEASES

185. Work on fruit rot has been recommenced and cultures of bacteria isolated from affected fruits have been established. Inoculation tests with these organisms are being carried out to discover whether the disease is primarily caused by them.

5.—CACAO

(i) SELECTION

186. No major developments have taken place during the past year, and work has been mainly concerned with maintenance of experiments laid down in previous years and accumulation of yield and other data for selection purposes.

187. Records of bean content have been taken from some 14,400 pods harvested from selection plots during the year.

188. (a) *Trinitario* (Old Stocks).—No progeny of old established *Trinitario* has yielded as well as *Amelonado*, but six trees have been found in the Serdang 15 progenies with outstandingly good pod values (weight of wet cocoa beans per pod). Characters of these six trees are as follows:

Trinitario S.15 Progenies

Pedigree	Tree No.	Wet Bean Weight gm.	No. Beans per Pod	Weight Wet Cocoa per Pod gm.
S. 15 x S. 43 ..	385	5	38	180
S. 15 x S. 43 ..	269	5	32	160
S. 15 x S. 43 ..	529	4	31	130
S. 15 x S. 68 ..	582	6	27	160
S. 15 x S. 68 ..	47	4	34	140
S. 15 x S. 68 ..	790	4	35	130
Amelonado Field Mean	..	3	38	110

189. (b) *Trinitario* (New, Imported Material)—(i) *Indonesian*.—Full experimental results for the five progenies under trial in a Latin Square (Experiment No. F.E.S.S. 115) for 1954 are not yet available, but, from records to the end of September, it is evident that some of these progenies compare favourably with *Amelonado*, and 24 trees have so far been selected for multiplication and further study on account of either high pod

values or high tree yield. The characteristics of the six best of these are given below:

Indonesian Seedling Progenies	Tree No.	Mean Bean Weight	Mean Beans per Pod	Mean Weight Wet Cocoa per Pod	Total Yield of Wet Cocoa per Tree	Selection
		gm.		gm.	kgm.	
Trin. Ind. D ..	466 ..	3 ..	40 ..	100 ..	8.9 ..	Yield
Trin. Ind. D ..	230 ..	3 ..	35 ..	110 ..	7.1 ..	"
Trin. Ind. A ..	195 ..	4 ..	31 ..	130 ..	7.3 ..	Yield and pod value
Trin. Ind. B ..	173 ..	5 ..	36 ..	170 ..	3.6 ..	Pod value
Trin. Ind. A ..	594 ..	4 ..	38 ..	170 ..	2.9 ..	"
Trin. Ind. B ..	474 ..	4 ..	36 ..	150 ..	4.7 ..	"
Trin. Ind. A ..	306 ..	3 ..	38 ..	150 ..	3.8 ..	"
Amelonado Field Mean..		3 ..	42 ..	120 ..	3.0	

In each of these progenies, variation of most characters, such as yield, pod value, pod type and growth habit, is very great. Pods in another progeny, Trin. Ind. E, range from Amelonado to Criollo in type and some 20 per cent. of the trees have white Criollo-type beans.

190. Of two other Indonesian progenies growing in the same field, D.R.38 is delicate and not doing well and D.R.2 is only represented by four seedlings which are, however, thriving.

191. (ii) *West African*.—Of 10 West African Trinitario progenies, planted in 1951, T.9 appears the most promising: 50 per cent. of the trees are in flower and a few have yielded good pods containing up to 150 gm. of wet cocoa. Though up to 40 per cent. of other progenies are flowering, the high loss of pods to pests in the field has prevented accumulation of data and held up selection.

192. (iii) *New Guinea*.—Seedling Keravat progenies in the same field as the West African Trinitario are also suffering from destruction of pods by squirrels and civet (*musang*) and the few pods harvested are poor; the average weight of wet beans per pod is 79 gm. and bean weight 2.6, but one tree, K.28, has pods giving 124 gm. of wet beans and bean weight of 4 gm.

193. (iv) *Ceylon*.—Buddings from Trinitario trees selected on an estate from material originating in Ceylon have come into bearing. Though, in general, beans are small, pod values are satisfactory, and clone K.1114 is quite promising. Four pods of K. 623 gave over 50 beans per pod.

Clone No.	Mean Bean Weight	No. of Beans per Pod	Weight Wet Cocoa per Pod
	gm.		gm.
1,025 ..	2.3 ..	46 ..	104
623 ..	2.6 ..	43 ..	113
793 ..	2.9 ..	43 ..	126
1,114 ..	3.2 ..	43 ..	139
714 ..	2.7 ..	34 ..	92
480 ..	3.1 ..	19 ..	58

194. (v) *Trinidad*.—Further importations of clonal I.C.S. material have been made but material of only three clones has survived. Of the 12 clones now represented in Malaya, eight have been propagated by budding, but none are yet in bearing.

195. (c) *Upper Amazon*.—An initial attempt to establish clonal material of Upper Amazon types imported *viâ* Kew failed, and at the second attempt one plant only of each of the three clones, N.A.33, I.M.C.60 and I.M.C.76, survived.

196. Of 39 seedlings established from open-pollinated Upper Amazon trees in West Africa, six red-podded trees are suspected of being Upper Amazon x Trinitario hybrids. This material is early in bearing and has fulfilled its initial promise of exceptional growth vigour. While both Upper Amazon and Amelonado have produced pods within 18 months of planting, in 25 months the former has produced an average of 3.4 pods per tree as against 0.09 in the latter.

(ii) BREEDING

197. Determination of self-compatibility of all experimental cacao material at the Federal Experiment Station, Serdang, is being carried out, except in the case of Amelonado and Criollo which are assumed to be self-compatible. This programme is now half completed. Some anomalous results called for a check on technique, which confirmed that only newly opened flowers should be used and a minimum of 30 pollinations per tree are generally necessary.

198. *Hybrids*.—A total of 72 plants of Na.32 (Upper Amazon) x Amelonado, obtained from an imported Nanay 32 plant which flowered in the basket but subsequently died, has recently been planted out.

199. A small progeny of 60 Amelonado x S.15 (Trinitario) hybrids is growing well and showing appreciably more vigour than the interplanted Amelonado controls.

200. Provisionally selected trees are being used to initiate an exploratory breeding programme aimed at producing small progenies from as many different types of cross as possible. Material representing self-compatible and self-incompatible Trinitario, Amelonado, Upper Amazon and Criollo types is being crossed in most of the possible combinations.

(iii) CACAO LEAF SAMPLING TECHNIQUE

201. With the probable establishment of cacao as a crop in Malaya, it is to be expected that chemical analyses of leaf samples will be required for diagnoses of nutritional and manurial problems. A start has, therefore, been made on development of a technique, by the analyses of leaves from healthy, well-grown, four-year old Trinitario and Amelonado trees at the Federal Experiment Station, Serdang. Analyses showed that the tips of the fans from the second jorquette had the highest content of nutrients while the base of the fan had the lowest.

(iv) PROCESSING

202. Early trials in laboratory preparation of cocoa products from West African Amelonado cacao, grown, fermented and dried at the Federal Experiment Station, Serdang, were successful.

203. *Fermentation*.—A start has also been made in the study of a micro-fermentation technique for use in future selection work. Two methods have been tried, "normal" fermentation after the method of De Witt, and "aseptic fermentation" after recent work by Wadsworth *et al.* The latter method has not been successful so far, and further trials await the arrival of the full paper to be published by Wadsworth. Meanwhile, the micro-fermentary (De Witt pattern) has been improved, and recent "runs" have shown quite good temperature control, producing beans of good average quality. West African Amelonado material is being used throughout.

(v) INSECT PESTS

204. *Cockchafers*.—Night observations were carried out on the movements of marked specimens of *Apogonia cribricollis* Burm. and *A. expeditionis* Rits. Recoveries of 5 to 14 per cent. of marked beetles were obtained on the few nights following release, and random movements of about 20 to 40 feet per night for these were recorded. However, no deductions of the movements of the remaining 86 to 95 per cent. of the beetles can yet be made. Further experiments are to be carried out.

(vi) DISEASES

205. Pod rots continue to be fairly common, but no virulent pathogen appears to be associated with them. *Botrydiplodia theobromae*, which occurs commonly on affected pods, was inoculated on to healthy pods but in no case did infection occur, even when the pods were injured.

6.—TEA

(i) SELECTION

206. Continued difficulty has been experienced in obtaining a satisfactory percentage in rooting of tea cuttings under conditions prevailing at Cameron Highlands. This problem is still under investigation and in consequence it has not yet been possible to commence planting field trials of clones from selected bushes.

207. With promise of better results, taking of cuttings from selected bushes was resumed in August and 5,104 cuttings from 50 bushes have been set. Unfortunately, continuous and heavy rain in the latter part of the year has retarded rooting and growth. Additional protection of rooting beds is now being tried.

(ii) DISEASES

208. *Blister Blight* (*Exobasidium vexans*).—The experiment laid down on an estate at Cameron Highlands to discover the effect of this disease on yield has been terminated after 15 months' plucking. A moderately severe attack during the period of

recovery from pruning resulted in a loss in yield of approximately eight per cent. Blister blight attack during plucking did not appear to affect yield.

7.—FIBRES

(A) *Ramie*

209. *Variety Trial*.—This trial, comparing 16 selected clones, has now been in progress for $3\frac{1}{2}$ years and 20 crops have been reaped at two-month intervals. Preliminary examination of the analysis of results from the first 18 reapings suggests that at least three varieties, Nos. 16, 40 and 107, give a high yield of shoot growth and No. 16 is probably to be preferred by virtue of a higher fibre content. There are also indications of variation in the economic life of plantings of different varieties. The indications, however, require confirmation.

(B) *Manila Hemp*

210. *Insect Pests*.—A new pest for this crop was reported in September on a Selangor estate where the weevil *Odoiporus longicollis* (Oliv.) was damaging the pseudostem. The closely related banana weevil, *Cosmopolites sordidus* (Germ.), was present in the root stock but banana is its preferred host. On advice to the manager, two spraying rounds were carried out on the estate in question with 6.5 per cent. gamma BHC wettable powder at 1 lb. in 17 gallons per acre and with $\frac{1}{4}$ gallon per acre of Dieldrex 15 at 1/50. The former gave more effective control.

(C) *Jute*

211. *Stem Canker*.—Stem canker, caused by a species of *Colletotrichum* of the *C. capsici* group, continues to be serious on the Segama variety. At the Federal Experiment Station, Kuala Lumpur, spraying with a copper fungicide considerably reduced the incidence of the disease.

8.—FOOD CROPS

(A) *Soya Bean*

212. Selection stocks, which consisted of two groups, one from seed obtained from a number of countries, and a second group solely of Indonesian origin, have been bulked and reduced from 78 to 38 strains. These have been planted for further study and selection in three groups according to whether they appear non-photosensitive or adapted to spring or autumn planting.

(B) *Groundnut*

213. At the commencement of the year, 211 selections were growing at the Federal Experiment Station, Serdang. From these, 214 selections were carried forward in the second crop which was harvested in November. In neither crop were growth conditions ideal, wet weather and excessive weed growth affecting the first crop, and drought and rat damage the second.

214. Nevertheless, relative yields of different selections appeared consistent with results from previous seasons, and the number of selections carried forward was reduced to 125.

Provided growth is good during the next crop, to be planted early in 1955, it should be possible to reduce the number of strains under selection sufficiently to plant them in a final replicated selection trial during 1955.

215. The opportunity has been taken to process and analyse a parcel of fresh groundnuts drawn from the selection area at the Federal Experiment Station, Serdang.

(C) *Sweet Potato*

216. The reference collection of varieties maintained at Serdang has been replanted and rearranged in accordance with a preliminary botanical classification.

217. A separate planting of all varieties is to be made to assess yield of shoots and select higher yielding varieties for growing as pig feed. Preliminary selections will, in due course, be compared in a replicated trial.

9.—VEGETABLES

218. At the Federal Experiment Station, Cameron Highlands, over a period of 15 months, increases in yield averaging 109 per cent. for carrots and 46 per cent. for French Beans have been obtained by spraying with copper fungicides for control of leaf blight of carrots (*Alternaria dauci*) and anthracnose of beans (*Colletotrichum lindemuthianum*).

10.—CLOVES

(i) INSECT PESTS

219. Encouraging results have been obtained against eggs and hatching larvae of both species of Cerambycid clove borers (*Niraeus tricolor* Newm. and *Chelidonium brevicorne* Miller) with dieldrin in concentrations as low as 0.09 per cent. actual.

220. A full report on a study of pests of the clove tree has been prepared.

(ii) DISEASES

221. The two diseases, die-back caused by *Cryptosporella eugeniae* and a restricted form of "Sudden Death" caused by *Valsa eugeniae*, were discovered in clove plantations in Penang. Previously they had only been recorded in Zanzibar. A survey showed that both fungi were of common occurrence, all plantations inspected being infected by one or other or both fungi.

222. *Valsa eugeniae*, which may attack through the roots or branches, appeared to be causing the more serious damage, many trees having been completely killed by this fungus. *Cryptosporella eugeniae* attacks only the aerial parts, but causes very severe die-back. Both fungi quite commonly occur on the same tree.

223. It is considered possible to control both diseases if control measures are vigorously applied. The diseases will continue to be serious, however, while the practice is adhered to of planting seedlings near moribund trees to replace these when they eventually die.

224. There seems no doubt that both fungi have been present in Malaya for some time.

11.—FRUITS

BANANA

225. The variety collection has been replanted on better soil at the Federal Experiment Station, Serdang, and recording of fruit and other varietal characters will recommence early in 1955, as soon as fruit becomes available.

12.—PASTURE AND FODDERS

226. Ecological observations and species analysis in line transects in the pasture experiment under various shade (Experiment No. F.E.S.S. 27) were continued.

227. Monthly sampling for protein analyses of grass in the manurial experiment on pasture under legume shade (Experiment No. F.E.S.S. 126) was continued. Crude protein has never risen above 3.0 to 3.2 per cent., the normal range being 2.8 to 3.0 per cent., which is not high enough (3.5 per cent.) for balanced fodder.

228. The opportunity was taken during the last quarter of the year to investigate methods of sampling and possible source of error both in field and laboratory. These results are in course of statistical analysis.

13.—MISCELLANEOUS CROPS

229. Projected selection work on improvement of tree fruits, coffee, vegetable crops, and pasture and fodder species has not yet commenced owing to lack of facilities and the preoccupation of available staff with other projects.

14.—PLANT SAMPLING AND ANALYSES

230. In plant samples rich in silica, dry ashing is a difficult procedure, and is essentially a slow process at relatively low temperatures. It has, therefore, been necessary to make suitable arrangements for larger dry ashing capacity to cope with all the samples being handled.

231. It has also been necessary to give further attention to the stabilisation of samples before or immediately after transport to the laboratory.

232. The most satisfactory basis on which to report and compare results of chemical analyses of plants is on percentage to dry matter, and, as protein and carbohydrate decomposition is almost inevitable in green plant samples, a research project has been initiated in the Chemistry Division to establish optimum harvesting, transport, and preservation conditions for field sampling of padi plants, grasses, and other crops. Polythene bags have been found reasonably satisfactory for collection and transport of green samples, but it is proposed to provide oven drying facilities at distant points from Kuala Lumpur. Also, oven capacity has been doubled in the Kuala Lumpur laboratory. Deep freezing preservation methods are also being tried on several different types of plant samples.



(Photo by permission of the Royal Air Force)

A view of the 60-acre rubber clonal seedling nursery in Selangor



Production of clonal seedling stumps by the Department for the Rubber Industry (Replanting) Board



(Photo by Dept. of Information Services, Federation of Malaya)

The Flame Photometer in use in the Soils Division



A Poultry course being held in the hostel built by the Rural and Industrial Development Authority at Gajah Mati Agricultural Station, Kedah

15.—SOIL INVESTIGATIONS

(i) SOIL SAMPLE ANALYSES AND LABORATORY ORGANISATION

233. There has been a considerable increase in the number of analyses (25,207) of soil samples with which the Soil Science laboratory has dealt during 1954—almost four times as many as in the previous year. This has been due, in part, to an increase in staff and the use of instruments, particularly the Lange flame photometer, but in greater part to the reorganisation of analysis methods and of working methods of the junior staff. Without sacrificing accuracy for speed, the junior staff have been taught quicker methods for obtaining standard weighings, filtering, etc. As much mechanisation as possible is being carried out and a new type of bottle shaker to take up to 100 bottles, and a mechanical (motor driven) pestle and mortar have been designed with the help of the Instrument Maker of the Survey Department. Racks with open drawers to store over 2,000 sample bottles have been made; and trolleys to move large numbers of containers are also used.

234. A large proportion of the analyses were connected with the various soil surveys. Such analyses are necessary in order to tie up chemical and physical characteristics with field classification.

235. With this reorganisation of working methods, modification of methods of analysis has also been made. New rapid methods for the determination of total sulphur and free sulphur in soils have been tried and may be developed for use with sulphurous soils. The use of the Lange flame photometer has made it possible to carry out analyses for potassium at a rate of at least 1,000 per week. Sodium and calcium determinations have also been done successfully, but are not yet on a routine basis. Some difficulty was found in determining calcium because of interference by aluminium and phosphate.

236. By introducing batch shaking and filtering, it is now possible to do 300 phosphorus analyses per week. The Rubber Research Institute of Malaya method of extraction with ammonium fluoride and hydrochloric acid adjusted to pH 1.8 has been put into routine use. Available P for inland soils ranges from 0 to 15 p.p.m. whereas coastal soils have values from 0 to 40 p.p.m.

237. The macro Kjeldahl method of nitrogen determination has been replaced by the micro method, and 250 to 300 analyses per week can now be made in place of the 60 to 100 previously done.

238. The methods of analyses used in the laboratory may be divided into four types—

- (i) Routine analyses applied to all soil samples,
- (ii) Special routine analyses (such as conductivity, sticky point, cation exchange capacity, soluble iron and aluminium, chlorides and sulphates, sulphur, etc.) applied to certain soil samples,
- (iii) Plant analyses, and
- (iv) Research analyses.

It is intended that these should be integrated as part of a monograph on soil survey—identification of soil types, methods of sampling, methods of analyses, and interpretation of analyses—as applied to Malayan conditions.

(ii) BASE EXCHANGE CAPACITY OF MALAYAN SOILS

239. Little time was available for actual research into the properties of Malayan soils, but some work was possible on exchangeable bases, and base saturation provides several clues to the morphology of the alluvial soils. Alluvial soils which are laid down under marine conditions are, as would be expected, higher in exchangeable calcium, potassium and, particularly, magnesium than river alluvium. Again, when the soils are subject to leaching, the sodium and potassium appear to move first, and the magnesium last. Thus the sodium-magnesium ratio could be used as a guide to the age of the soils. This is important for a long term view of the fertility of padi soils. In areas like Tanjong Karang, the original sea clay is very fertile because it has not been subjected to much leaching until drained and cultivated. Irrigation of such an area with acid, peaty water, carrying no silt, will probably lead, in time, to a reduction in fertility.

240. In view of this, work has been directed towards finding methods suitable for determination of exchangeable bases and base saturation on large numbers of samples, and an enclosed automatic leaching apparatus has been set up. Sodium, potassium and calcium in the extracts can be determined using the flame photometer, but its sensitivity is insufficient for magnesium determination at present. Colorimetric methods have been tried and an amplifier for the photometer has been ordered.

241. The “versenate” method has been tried out but it fails when iron is present in excess in the leachings. A colorimetric method, using Titan yellow, has given unexpectedly high results.

(iii) TANK EXPERIMENTS WITH PADI SOILS

242. In the padi cage at Kuala Lumpur, the pots have been replaced by large concrete tanks each with an area of approximately 10 sq. ft. and capable of holding nine padi plants. A good coastal clay soil has been obtained from Tanjong Karang, Selangor, an inland alluvium from Kendong, Negri Sembilan, a sulphurous *gelam* swamp soil from Tanjong Minyak, Malacca, and a peat from Jalan Kebun, Selangor.

243. The tanks are constructed in such a way that they hold a layer of soil 2 ft. deep on top of a layer of gravel. There is provision for drainage and, if desired, facilities for collecting the drainage water. Irrigation is from tanks supplied by mains. Experiments projected for these tanks are: drainage during the growing season versus no drainage; drainage during the off-season versus waterlogging; and various types of manurial and liming experiments. In the 1954-55 season the plants were grown without any differential treatment.

244. *Padi on Peat.*—Invariably, padi grows poorly on peat in normal field conditions, and it is of considerable interest that the

padi plants growing in the typical, poor coastal peat transferred to the experiment tanks in Kuala Lumpur from Jalan Kebun are robust and well grown, though not highly tillered. The peat did not dry out during transfer, nor is bottom drainage yet used in the tanks. There is, however, a dense mat of roots on the surface of the peat, and it may be that the free-flowing, fresh (tap supply) water supplied to the tanks provides much more oxygen than normal, or may result in a much higher pH than peaty water would allow.

245. It is anticipated that the crop may be light in ear, but the plants are growing very healthily and the crop will be observed with much interest; if the crop is good, the conditions in these tanks containing peat will provide a most important investigation.

(iv) *GELAM* SOILS

246. As noted in the Report for 1953, a considerable amount of field work was carried out on *gelam* soils in that year. The only new area to be examined during 1954 was a part of the proposed North Kedah-South Perlis irrigation scheme. This area has at one time been *gelam* (*Melaleuca leucadendron*) swamp, but is now largely opened up for padi growing.

247. Sufficient field examination has now been carried out on *gelam* areas to show that *gelam* trees can be found growing in three distinct ecological conditions. In Malacca, they occur on swampy, heavy textured soils which are quite high in sulphur, and these are really the biggest problem. In Trengganu and Kelantan, they occur on very poor peat and sandy soils and do not appear to be always associated with high sulphur content, although some of the *masam kelat* (Malay=very sour) soils are very sulphurous. The extreme poverty of the soils seem to be the reason for the growth of *gelam*. In Kedah, the *gelam* trees are mainly very old, and young *gelam* is not much in evidence. The soil is of medium texture but it does not appear to contain dangerous amounts of sulphur.

248. Chemical studies on the soils from these areas have been carried on during the year. The main features which have been examined are the exchangeable bases, base exchange capacity and the movement of iron, aluminium and manganese in acid soils. The soils from Malacca *gelam* areas are very poor in bases and in plant nutrients generally.

249. It is of interest to note that, in the experiment tanks, the padi plants in the more sulphurous sub-soil from Tanjong Minyak are growing much less poorly than those in the top-soil from the same place; there is also much more H_2S emerging from the top-soil. Thus it would appear that the form in which the sulphur occurs, as well as its quantity, is important.

(v) WATER MOVEMENT IN COASTAL CLAYS

250. Water movement in the soil is of particular significance to growth of padi plants, and the alternation of drainage and flooding, essential for successful cultivation, results in physical, chemical and biological changes which have not yet been much investigated in tropical conditions.

251. Small scale exploratory experiments have been commenced in Kuala Lumpur under controlled conditions in bitumen-lined, concrete tanks, and information so obtained will provide useful guidance in the design of the necessary subsequent field experiments.

252. A site has been chosen at Sungei Burong, Selangor, and preliminary investigations of soil water movement in typical, fine clay padi soil have been carried out by means of series of auger holes, trenches, puddled cores and bunds. It is evident that nearly all water movement in the soil is lateral at a depth of 20 to 24 in., and that a high degree of water control can be obtained with measurable, controlled water supply, bunds with puddled cores or soil cement cores to a depth of 27 to 30 in., and adjustable water gate drainage.

(vi) SOIL SURVEYS

253. (a) *Singapore*.—A special survey was carried out at the request of the Government of Singapore on 16,000 acres of land with a view to the identification of possible food crop areas in Singapore. The soils are derived mainly from Triassic sediments of variable composition and the complexity of the resultant soil pattern underlines the importance of the geology as the chief influence on soil formation.

254. The soils have generally low nutrient levels and poor physical structure. They are mainly under scrub, old rubber and fruit. The most promising soils are those in the valleys. Field mapping, which included the plotting of soil, slope, and erosion boundaries, was carried out using aerial photographs on a scale of 8 in. to 1 mile, and a final soil map on the 2½ in. to 1 mile scale showing the boundaries of 17 soil series was prepared from this field data. During the survey, 64 pits were examined and sampled. A full report of the work has been prepared and is being published.

255. (b) *Trengganu*.—In Trengganu there are some promising cacao soils, and cacao, established on an estate scale, is growing well in one locality. The immediate problem is to find the extent of these good soils, and, with this in view, the Geologist (Soil Survey) spent the latter half of the field season in Trengganu. Soil surveying in pathless jungle presents many difficulties, and to find a system of survey which will give useful information without being unduly costly has been one of the main aims. Even in dry jungle, retiling is necessary, and it has been found that in a 10-day trip only 11 to 12 miles can be surveyed.

256. Classification has been made in soil series but the reconnaissance mapping has, at present, been confined to the plotting of inclusive soil association boundaries, a soil association being defined as a group of related soils developed over an area of similar geology and topography.

257. The wider occurrence of low granite outcrops in some areas differs from that of the west coast; the granite, too, is less acid. There are also very large areas of poor shale and sandstone soils, with a belt of very poor sandy soil along the coast. Wide, deep swamps are a feature of some of the areas near the coast.

The larger rivers have wide flood plains which include some good soils probably suitable for padi.

258. The eventual aim is to produce a reconnaissance soil map of Trengganu showing all the soil associations in the State, with promising cacao and padi soils mapped in greater detail. The reconnaissance map will be produced on a scale of 3 miles to the inch.

259. (c) *Temerloh-Marani Road Area*.—The area bounded by the Jerantut-Marani and Marani-Temerloh roads and the Mentakab-Jerantut railway line is practically unexplored geologically, but the exposures on the new Temerloh-Marani road indicate some good andesite soils in the area. In company with a Geologist from the Geological Survey Department, a short exploratory survey was carried out, and from this it would appear that further exploration in the area would be well worthwhile. A deep, good textured soil is developed over andesite and it looks particularly suitable for high fertility crops.

260. (d) *Trans-Perak Padi Scheme*.—Soil sampling in the swamps of the Trans-Perak area was completed towards the end of the year. The sampling started in 1948, and thus continued intermittently for over six years. During that period about 3,300 soil samples were taken from an area of almost 200,000 acres, the largest area to be mapped in Malaya.

261. The extent of the area is such that enough skilled staff to undertake the soil survey were impossible to obtain. The difficulty of movement can be judged from the fact that it took a Soil Surveyor 22 days to cover 12 miles of swamp. The method finally adopted was for unskilled staff to take samples by a standard method at regular intervals. This involved transport and examination of large numbers of samples, but it was the only way to deal with such a large swamp area. At the time of sampling, the depth of peat, if present, was measured with a Hiller type peat borer.

262. Soil maps have been prepared showing the distribution of the different depths of peat and the various textural classes of mineral soils. A full report on the soils of the area and the methods of survey adopted is being prepared.

263. (e) *Briah Swamp*.—This is an area of approximately 25,000 acres in the Krian area of Perak. A simultaneous topographical and soil survey was carried out by the Survey and Agricultural Departments and methods similar to those in the Trans-Perak area were used. A considerable part of the area is covered with peat, but this is not so deep as in some parts of Trans-Perak.

264. (f) *Kuala Langat*.—In the Kuala Langat area of Selangor, there is an area of 140,000 acres of swamp which has been considered to be potential padi land. A topographical survey is being carried out in the northern part and soil survey is proceeding at the same time. At the end of the year, 15,000 acres had been surveyed, and this was found to be nearly all deep peat. Over 90 per cent. of the samples have less than 10 per cent. ash, i.e., over 90 per cent. loss on ignition.

265. (g) *Pulau Tawar*.—Analyses from a soil survey of the small Pulau Tawar area of river alluvium on the east bank of the Pahang River south of Jerantut, showed that there are permeable, sandy layers in two sections of the area at depths of 12 to 18 in., which explains the difficulty of maintaining water levels.

266. (h) *Padi Experiment and Test Stations*.—Large numbers of soil samples are being taken at various Padi Test Stations by State and Settlement staffs, and these are being examined as time permits for the systematic survey of soil conditions of all Padi Experiment and Test Stations.

16.—PLANT NUTRITION STUDIES

267. Leaf analyses of padi plants have been carried out mainly in relation to padi manurial experiments. Leaf analyses of oil palms have been concerned with a study of leaf “bronzing” at the Federal Experiment Station, Serdang, and mineral deficiency symptoms on various oil palm plantations. A study of uptake of minerals in the cacao plant has been commenced.

17.—MISCELLANEOUS NEW RECORDS OF DISEASES AND INSECT PESTS

268. Among the many new diseases and pests investigated during the year, which have not been previously recorded, the following may be noted:

Leaf spot of pineapple	...	<i>Asterinella stuhlmanii</i>
Leaf rot of <i>Stylosanthes gracilis</i>		<i>Colletotrichum</i> sp.
Leaf spot of Chinese cabbage		<i>Colletotrichum</i> sp.
Basal rot of Chinese cabbage		<i>Sclerotium rolfsii</i>
Stem canker of rambutan	...	<i>Stilbum</i> sp.
Flower chafers on coconut palm	... ..	<i>Macronota regia</i> F.
Mites on seedling rice	...	<i>Tetranychus</i> sp. near <i>oryzae</i> Hirst.
Kapra beetle on stored rice	...	<i>Trogoderma granarium</i> Everts

18.—RICE STORAGE

269. The Chief Research Officer and the Senior Entomologist continued as members of the Government Committee formed to study the conditions necessary for long-term storage of food, including silo storage of milled rice. The Senior Chemist also attended Committee meetings towards the end of the year.

19.—INTERNATIONAL RICE COMMISSION

270. The Senior Botanist represented the United Kingdom (Malaya) at the 5th Meeting of the International Rice Commission in Tokyo in October, 1954, and served as Vice-Chairman of the Rice Breeding Working Party.

20.—PLANT PROTECTION AGREEMENT FOR SOUTH EAST ASIA AND THE PACIFIC REGION

271. The Chief Research Officer (as United Kingdom delegate) and the Acting Senior Plant Pathologist attended the

Plant Protection Regional Agreement Meeting sponsored by F.A.O. and held in Singapore from the 13th to the 17th December, with a view to international agreement being reached on the co-operative measures necessary on a regional basis for the protection of crops against dangerous diseases and pests, and in particular on measures to exclude South American Leaf Blight of Hevea from the Region.

B.—AGRONOMIC AND LIVESTOCK INVESTIGATIONS

1.—CROPS

(A).—Padi

(i) WET PADI

(a) *Mechanisation*

272. Harvesting trials, which commenced in Kedah at the end of 1953, were continued in the north during the first quarter of the year. Trials with prototype headers were unsuccessful, but the McConnel-Jay corn windrower showed promise.

273. The Massey Harris Rice Special self-propelled combine on tracks was tested and performed quite well in large fields. The working rate varied from 0.35 to 1.25 acres per hour with an average of 0.56 acres per hour, which is equivalent to perhaps 190 acres per unit per season. The cost varied greatly with condition of crop, averaging about the same as for hand harvest, or 15 to 20 per cent. of the value of the crop. In good conditions the cost can be much cheaper than hand harvesting.

274. Threshing tests showed that the performance of foot-operated threshers is little better than that of hand threshing by traditional methods. The small, engine-driven Tullos thresher reduces labour and increases output but does not reduce cost. The Andes thresher has a low output and costs are therefore high; however, it can be tractor-mounted so that it can follow the reaper into fields.

275. For contractors and large farmers the medium-sized Turner thresher does satisfactory work but is not manoeuvrable. The similar Garvie has not yet been fully tested. The prototype Danish Andro has a high output but is rather too large and expensive for smallholders. A similar, semi-mounted machine has been ordered for trial during the 1955 harvest.

276. The cost of threshing with a Turner varies from 5 to 10 per cent. of the value of the crop according to whether it has been reaped by hand-knife or sickle.

277. Tractor-mounted transport boxes and jib transporters have been tested in Perak and costs calculated. They save labour but are no cheaper to use than the buffalo sledge.

278. Two types of baler have been tested, one in Kedah and Kelantan and the other in Negri Sembilan. The Opperman Lightweight Baler required a crew of four and produced some 1,375 lb. of baled straw per hour at a cost of about \$7.98 per ton. The semi-mounted Nicholson Baling Press Type P. B. 1 required a crew of three and produced 1,200 lb. of bales per hour at an

approximate cost of \$11.82 per ton. It is much cheaper to produce a bale weighing 50 lb. than one weighing 30 lb. because of the relatively high cost of twine.

279. The total cost of collecting straw by tractor-mounted buckrake, baling it, carting the bales to the roadside and transporting them 10 miles by lorry was estimated at \$14.43 per ton.

280. A study has commenced on different types of animal drawn implements and a 700 lb. dynamometer has been constructed for this purpose.

281. Several types of winnowing fans have been developed for use in areas not favoured by a dry, windy harvest season. These fans can be driven by hand, foot pedal or small engine.

282. Seed fiddles of various types have been used and have given good results using seed soaked for 48 hours, germinated for a further 36 hours and then dried off with rock phosphate. Seed rates as low as 20 lb. per acre have given good results but they require skilful operation of the fiddle. Swath widths of 19 to 22 ft. with a seeding rate of 3 acres per hour have been recorded under good conditions. Two-way seeding with a somewhat higher seed rate would probably give a more even stand.

283. Boom sprayers have been tested for the application of selective herbicides to the growing crop. These require a two-man team, each with a pressure retaining knapsack sprayer joined to a common, light, 12 to 16 ft. boom by means of short lengths of rubber hose. This method of application has been shown to be both flexible and efficient.

284. Dosage trials with different selective herbicides at different rates are in progress. Interim results favour the cheapest sources of 2, 4-D or M.C.P.A. at a dosage of not more than 1 lb. acid equivalent per acre.

285. Planning has commenced for the mechanical cultivation of a 50-acre farm in the Trans-Perak area, for which Colonial Development and Welfare funds have been made available.

(b) Fertilisers

286. Trials with different types of nitrogenous fertilisers have shown that sulphate of ammonia is almost always superior to nitrate of soda and never inferior to it on an equivalent nitrogen basis. Mixtures of sulphate of ammonia with mono-ammonium phosphate have shown no superiority over equivalent mixtures with the phosphorus present as superphosphate. Placement of nitrogen top-dressings about 4 in. below the surface has shown no superiority over broadcasting on the mud surface.

287. Small applications of calcium salts have shown beneficial effects at two localities in the absence of NPK fertilisers but not in their presence. Similarly, magnesium has not led to any regular response in the presence of NPK but it may sometimes be beneficial.

288. Trials with different types of phosphatic fertilisers are of great importance to Malaya since the cost of water-soluble P_2O_5

is 282 per cent. of that of the insoluble form present in rock phosphate, while some high-analysis bat guanos may be even cheaper. One series of 15 trials, continued for three years, has now shown that response to phosphate was general in 10 localities and that equivalent dressings of the soluble form were superior in about half these localities. A logical follow-up to this result was to test a half-dressing (50 lb. per acre of P_2O_5) of soluble nutrient against twice that amount of two forms of insoluble P_2O_5 in the presence of nitrogen in 200 4-plot trials on cultivators' fields. Responses to the different fertilisers were so similar that it clearly pays to use the cheaper, double dressing of the insoluble fertilisers—i.e. rock phosphate or bat guano. However, it is only in Kedah and Perlis that high grade bat guano is at present available at reasonable prices.

289. Different forms of rock phosphate and of similar insoluble fertilisers are also being tested on an equivalent P_2O_5 basis. No differences have been detected, so there can be no justification for choosing any but the cheapest source of P_2O_5 which, at present, is Christmas Island rock phosphate.

290. Nursery manuring has been studied in two series of trials, one of which is still in progress. The application of 2 lb. of mono-ammonium phosphate per gallon of seed to the nursery resulted in mean positive yield responses of from 100 to 779 lb. per acre of grain at nine localities, with a maximum response for one year of 1,321 lb. per acre.

291. Pre-soaking seeds in solutions of potassium or mono-ammonium phosphates may sometimes also lead to large responses in yield but, where these occur, it is of equal value and usually easier to apply the phosphate to nursery beds.

292. Very valuable information has been obtained from a widespread series of small trials on cultivators' land. There were 458 of these in the 1953-54 season in seven States and the two Settlements.

293. Factorial NPK trials have given such useful information on the relative importance of these three major nutrients that the number of such trials was increased in the 1954-55 season.

294. Two seasons' results have now been obtained from a spacing and manorial experiment in north Kedah. The spacings ranged from 6×6 in. to 18×18 in. The closer the spacing the greater was the yield of grain and the smaller the number of tillers per plant. However, the larger tiller number at the wider spacings was insufficient to make up for the smaller plant numbers. There was a clear response to fertiliser, greatest at the closest spacing, but this effect did not differ greatly at the other spacings. When the cost of close transplanting is considered it seems likely that the optimum for this particular locality is about 9×9 in.

(ii) DRY PADJ

295. Limited experiments continue at two localities in Kelantan and one in Pahang. All these indicate that, given a good north-east monsoon, dry padi may be expected to show spectacular responses to N, P and K. In so far as the soils concerned

are some of the least fertile in the country, manuring can be guaranteed to give a regular response; however, in so far as the mean yields are low because of the occasional crop failure in dry seasons, it is more speculative to manure dry padi than wet padi.

(B).—Oil Palm

296. An examination of experimental results from a series of manurial experiments on a south Perak estate brought to light a small response in yield from 26-year old palms growing on an alluvial clay to irregular applications of nitrogen as sulphate of ammonia. A 72-plot multi-factorial manurial trial has since been laid down on the same estate to test the effect of different levels of N, P, K and Mg on the growth and yield of young palms planted in 1947.

297. In a variety and type of manurial experiment at Serdang, the field average yield of bunches for 1954 was 4.5 tons per acre or, at 14.37 per cent. extraction rate, 0.65 tons of pericarp oil. The best variety yielded more than twice the worst, but presence or absence of calcium in the NPK mixture appeared to have no effect on yield.

298. In the replanting experiment at Serdang the young palms are very backward where the old palms were felled three years after replanting. However, now that final felling has been completed the backward palms are making fair progress. Mean heights in November are summarized below:

	Mean Height cm.
A. Old palms felled before replanting ...	1,236
B. Old palms felled 1 year after replanting	1,074
C. Old palms felled 2 years after replanting	884
D. Old palms felled 3 years after replanting	638

The "A" treatment palms are now in bearing.

(C).—Coconut

299. In a manurial trial situated on infertile coastal sand in Trengganu, the first application of fertilisers was given in August after recording pre-treatment yields for one year.

300. No serious work has been possible on the west coast coconut soils since funds available were inadequate for opening up the new Federal Experiment Station, Telok Bharu, in south Perak. A start, on a small scale, is being made in 1955.

301. In a cultivation trial on an estate on the Selangor coast, disc-harrowing over a five year period has been shown not to be harmful and is much cheaper than hand slashing. The mechanical treatment favours the growth of the creeping cover *Mikania scandens* at the expense of grasses.

302. A small manurial experiment at Serdang is still in the establishment stage and the experimental treatments have not yet commenced.

(D).—*Pineapple*

303. In August, it was possible to post an Agronomist to the Federal Experiment Station, Jalan Kebun, Selangor, and he is now in direct charge of all pineapple experiments on peat soils both at that station and at Alor Bukit in Johore.

304. Type of potash trials in both Johore and Selangor have shown that where the fertiliser is applied to the soil the muriate (chloride) is as efficient as equivalent sulphate. However, if the potash is applied to the outer leaf axils after mixing with five times its bulk of peat the chloride causes severe scorching. Similarly, if potash is to be applied as a nutrient spray the chloride should be avoided.

305. A rate of potash trial at Jalan Kebun has indicated that applications exceeding 100 lb. potash per acre per crop may reduce yield unless balanced by nitrogen. However, the highest fruit quality went with 200 lb. K_2O per acre for the Singapore Spanish variety and with 100 lb. K_2O per acre for the Sarawak.

306. In a phosphate and magnesium trial, the first harvest showed no benefit from fertilisers and there was some evidence that the kieserite (magnesium sulphate) may have reduced yield by lowering the fruiting percentage.

307. No shortage of minor elements has been demonstrated on the newly opened-up fields at Jalan Kebun, Selangor, although widespread benefit has been obtained from copper sprays in the Johore pineapple areas. Copper sulphate solution and certain proprietary sources of copper are inclined to cause scorch but Bordeaux mixture gives good results. An apparently satisfactory alternative is to mix powdered copper sulphate and apply it dry as 5 per cent. of the NPK fertiliser dressing. There is no evidence to show that benefit is gained from more than a few pounds of copper sulphate per acre, but applications of up to 50 lb. have been given in some areas because of the remarkable improvement achieved with the first application and also in the belief that Bordeaux mixture helps to control mealy-bug wilt.

308. Results of harvests from a ridging and spacing experiment for the first 20 months from planting have been interesting. Where Singapore Spanish variety is grown at 6×2 ft. on ridges the fruiting percentage is double that on the flat—41.0 per cent. compared with 20.5 per cent. Subsequently, however, roots have become exposed and leaves are now narrow and thin on the ridges. There is a marked tendency for Sarawak plants grown on ridges to fall over.

309. Paired rows of Singapore Spanish plants on raised beds have yielded well but fruiting plants of Sarawak when so grown tend to fall over. Growth and yield of both varieties when grown on the flat at very close spacings have been poor.

310. There is strong evidence from two trials that rock phosphate is superior to single superphosphate, although this difference has not yet attained statistical significance. Both phosphate fertilisers were applied at equivalent rates of P_2O_5 per acre.

311. Observations on flower induction indicate that carbide solutions are superior to A.N.A.* and dry carbide.

312. A field layout has been agreed on for mechanisation trials, and a tractor-mounted boom sprayer is being developed.

313. Observations are in progress on the application of major nutrients in spray form. It has been established that, under certain conditions, concentrations of salts ranging from 20 to 40 per cent. can be applied to pineapple foliage without causing scorch. This method promises to effect a great saving in fertiliser and it gives a visible response within five days. It seems that chlorides must not be used and work is in progress using the following fertilisers:

sulphate of ammonia or urea,
mono-ammonium phosphate, and
potassium nitrate.

All these are completely soluble and leave no solid residue.

(E).—*Cacao*

314. The important manurial trial on Rengam series soil, overlying granite, at Jerangau Estate, Trengganu, completed its third year in November. Girth measurements have again emphasized the paramount importance of adequate phosphate for growth of young Trinitario cacao. This is shown clearly by the following mean girths, in cm.:

	p ₀	p ₁	p ₂	k ₀	k ₁	k ₂	Mean
n ₀	10.08	12.65	14.82	12.78	12.37	12.40	12.52
n ₁	9.42	12.88	15.77	13.85	12.12	12.10	12.69
n ₂	8.63	13.53	11.62	9.90	11.08	12.80	11.26
	(± 1.1251)			(± 1.1251)			(± 0.6496)
p ₀	—	—	—	9.37	9.53	9.23	9.38
p ₁	—	—	—	12.58	13.12	13.37	13.02
p ₂	—	—	—	14.58	12.92	14.70	14.07
				(± 1.1251)			
Mean	9.38	13.02	14.07	12.17	11.86	12.43	12.16
±0.6496							

The linear effect of phosphate was highly significant.

315. Since it is appreciated that this trial will not give a fair indication of the fertiliser requirements of mature cacao because of the uneven growth, another trial has been planned wherein all plots will receive uniform phosphate applications for at least the first three years of growth. Nursery seedlings of Amelonado are being raised for planting out in this experiment in 1955.

* Alpha naphthalene acetic acid

316. In a Trinitario spacing trial planted at Jerangau Estate in May, 1951, the mean girth measurements have been as follows:

Spacing ft.	MEAN GIRTHS		
	May, 1952 cm.	May, 1953 cm.	June, 1954 cm.
8 × 8	5.32 ..	10.12 ..	14.33
10 × 10	5.27 ..	9.84 ..	14.08
12 × 12	6.10 ..	11.03 ..	16.09
S.E.	± 0.2455 ..	± 0.5682 ..	± 0.8962
M.S.D. 5 per cent. ..	0.7736 ..	1.7904 ..	2.8238

The observed differences did not achieve statistical significance.

317. Another spacing trial was laid down on this estate in February but with West African Amelonado cacao. Treatments tested were 680, 551 and 435 plants per acre or 8 × 8 ft., approximately 9 × 9 ft., and 10 × 10 ft. respectively.

318. In a spacing and thinning trial in which Trinitario cacao was planted in October, 1951, growth has been satisfactory and some thinning was carried out in the second half of the year. The closer-spaced cacao has now closed its canopy and is beginning to shade out the ground cover. Height and girth measurements were made in November and are summarized below:

	Cacao Planted 10 × 10 ft.	Cacao Planted 5 × 5 ft. and Thinned	S.E.
Mean girth (cm.)	17.83 ..	16.37 ..	± 0.8254
Mean height (cm.)	323 ..	354 ..	± 14.893

319. Intensive studies have been carried out at the Federal Experiment Stations, Serdang and Jerangau, on improvement in the technique of raising cacao seedlings. These have stressed the importance of a well-aerated, moisture-retaining basket compost with an adequate supply of available phosphorus and a reaction only slightly on the acid side of neutral. A completely standard compost is not practicable in all localities but the standard Serdang mixture has given good results, and this is given below:

7 parts loam, pH 5.5 to 6.0	...	...	} plus 1 oz. double superphosphate per basket
3 parts dried cattle manure	...	...	
2 parts sharp sand	...	...	

Where good textured topsoil is available, as at Jerangau, a simplified basket compost can be used consisting of topsoil only plus $\frac{1}{2}$ oz. each of double superphosphate and ground limestone per basket.

320. Leaf scorch of both seedlings and mature cacao is thought to be due to low availability of P_2O_5 consequent on an acid reaction of the soil. However, it is possible that some additional factor is involved and investigations are continuing.

321. The establishment of basket nurseries is an expensive operation and investigations have been aimed at reducing the cost of this either by planting seed at stake or else by using cheaper containers. Early trials with sowing seed at stake have revealed the importance of removing the mucilage from seeds before sowing them. In certain low-lying forest areas such seeds are very

susceptible to damage by rodents whereas in drier areas this does not apply. In no case has growth of such seedlings been satisfactory and the method cannot yet be recommended.

322. Several brands of paper and fibre pots have been tested but none has proved satisfactory. However, the use of single-ply veneer tubes has shown great promise since they are very cheap and can be used several times. Their use was pioneered by the Silviculturist of the Forest Department.

323. An experiment on the bare-root transplanting of Amelonado seedlings raised under hard and soft nursery conditions has been laid down at the Federal Experiment Station, Jerangau, and it is planned to test six different sowing dates.

324. At the end of the year there was a total of 13 agronomic experiments on Agricultural Stations and 16 co-operative ones on estates. During the year eight trials were concluded on Stations and three on estates. Most of the trials which stopped had a record of poor growth of cacao. Perhaps the most interesting new development to report from estate trials is the considerable promise shown by cacao, particularly Amelonado, when grown under the shade of tall and dwarf coconuts on well-drained alluvial soils in south Perak and north Selangor. These indicate that intercropping is practicable and early growth suggests that cacao will be a success. There is no indication yet that coconut yields will be affected adversely. Problems of early shade and nursery technique are now being studied.

325. Squirrels, tree-shrews, monkeys, civet-cats, rats and porcupines can all become serious pests on cacao estates, and records have been kept of their relative importance. *Musang* (civet-cats) are the worst pests at Serdang, Selangor, but the tree-shrew, *Tupaia glis*, and the red-bellied squirrel, *Callosciurus notatus*, are perhaps the chief offenders in Trengganu and north Kedah. Trapping is often more effective against tree-shrews than squirrels; shooting is probably the best control method but the use of animal deterrents may be of value in special circumstances.

326. Observations in Perak have indicated that, where soil conditions are favourable, Amelonado cacao can be established under the shade of established durians.

(F).—Tea

327. Yields of tea for the first 2½ years of the pruning cycle, commencing from the date of pruning, for a nitrogen manurial experiment at the Federal Experiment Station, Cameron Highlands, are summarized below:

MEAN YIELDS IN LB. PER ACRE OF MADE TEA AT 22 PER CENT.							
CONVERSION							
ANNUAL APPLICATION OF NITROGEN							
		Nil	40 lb.	80 lb.		120 lb.	
		YIELDS					
First year	444	..	446	..	451	..	474
Second year	939	..	970	..	994	..	1,032
Half of third year	398	..	440	..	451	..	495

328. Control yields were very high indeed for highland tea and increments of made tea from the use of 40 lb. nitrogen were as follows:

First year	...	...	...	10 lb.
Second year	...	...	...	31 ..
Half of third year	...	...	...	32 ..

329. An annual basal dressing was given which consisted of 30 lb. per acre each of P_2O_5 and K_2O as Christmas Island rock phosphate and muriate of potash respectively. The nitrogen was applied as sulphate of ammonia.

330. The price of tea is now so high that these small increments make such nitrogen manuring an economic proposition. It would probably be even more profitable where control yields were lower.

331. The first year's yields from an NPK factorial trial have given no result of interest. The mean yield was 467 lb. of made tea per acre.

332. A tea pruning and disease control experiment which was laid down in early 1953 at Cameron Highlands completed its first year of the first pruning cycle on the 13th November, 1954. Treatments under test are as follows:

- P_1 —Hard pruning, 12 in. above ground; no rim lungs.
- P_2 —Medium pruning, 16 in. above ground; one rim lung.
- P_3 —Light pruning, 20 in. above ground; two rim lungs.
- P_4 —Hard pruning, first cycle; medium, second cycle; light pruning in the third cycle.

Each plot was split for spraying against blister blight, during recovery from pruning, versus no spraying.

333. First year's yields, in lb. green tea per acre, are summarized below:

	P_1	P_2	P_3	P_4	Total
Sprayed ..	481.0 ..	494.5 ..	568.5 ..	488.5 ..	2,032.5
Not Sprayed ..	468.5 ..	512.5 ..	568.5 ..	476.0 ..	2,025.5
Total ..	949.5 ..	1,007.0 ..	1,137.0 ..	964.5 ..	4,058.0

334. The lightest pruned bushes showed the earliest recovery but produced considerable *banjhi* leaves, indicating low vigour. P_1 and P_4 plots were slowest to recover, with P_2 ones intermediate. Only the unsprayed plots were affected by blister blight but attack was not severe.

335. There are no experimental records to quote from lowland Stations. At Serdang, the only important work in progress is the gradual bulking up of clones, and the speed of this work is determined by the availability of funds since it is most expensive.

336. In an intercultivation trial on an estate in north Selangor, three hedges of tea, planted $2 \times 4\frac{1}{2}$ ft., have been established successfully under the shade of old, tall coconuts. Plucking has not commenced yet. The soil is heavy but relatively free-draining alluvial clay. Intermediate shade is provided by both

Gliricidia sepium and *Erythrina subumbrans*, the latter being the more vigorous.

337. Practical experience on other estates situated on alluvial clay has emphasized the importance of maintaining a ground-cover of annual weeds, excluding grasses, and of such weak-growing bush-covers as *Cassia occidentalis*. Clean weeding must be avoided at all costs.

(G).—Coffee

338. Two manurial trials are in progress on deep peat soil at the Federal Experiment Station, Jalan Kebun, on the Selangor coast. Liberica coffee was planted out in these two trials in May and June, 1953, and subsequent growth has been very satisfactory. A fairly general outbreak of Rust, *Hemileia vastatrix*, occurred in October but was soon controlled by spraying with a copper fungicide. Heavy flowering commenced during the second half of the year but flowers and young fruit have been removed and the bushes will be kept clear until they are two years old. Observations on the major-element trial suggest that applications of potash and surface peat-burning both benefit early growth, whereas liming may be harmful. There is little difference in growth to note in the minor-element experiment except that plots receiving copper appear to be doing best.

339. In an intercultivation trial with old coconuts, Liberica coffee has been established without difficulty. Two spacings are under trial: a single row with bushes spaced 6 ft. apart and a double-row spaced 10 × 8 ft. All bushes look healthy but there have been a few casualties caused by root-disease. A small variety trial with Arabica coffee is in progress at the Federal Experiment Station, Cameron Highlands, at an altitude of 4,700 ft. A.S.L. The two varieties under test are Mysore and Blue Mountain. Because of the shortage of flat land in the mountains there is no commercial interest in highland coffee.

340. At the Federal Experiment Station, Serdang, a shade and variety trial which was planted in 1948 is still in progress. Yields of dried beans, in lb. per acre, for the year 1954 are summarized below:

Variety	No Shade		Light Shade		Heavy Shade		Mean
Liberica ..	555	..	322	..	223	..	367
Uganda ..	77	..	37	..	52	..	55
Mean ..	316	..	180	..	137	..	211

A certain amount of borer damage was recorded in the trial and there is evidence that this was worst with unshaded Liberica.

(H).—Fibres

(i) MANILA HEMP

341. A variety trial at Sungei Ruan, Pahang, came into bearing in June. The best growth here, as elsewhere, has been shown by Tangongon and early yields support this observation.

342. At Serdang, Tangongon continues to give the highest yield of six varieties under test, but Serdang C yielded almost as

well although it has a very low fibre content. Annual yields for the last four years have been as follows:

	ANNUAL YIELD OF FIBRE PER ACRE		Fibre Content per cent.
	Mean	Maximum	
	lb.	lb.	
Tangongon	608	835	2.57
Serdang C	510	648	1.38

Fibre from Serdang C is of very high quality. Tangongon and Bangulanon both grow well on alluvial clay-loam at Degong, Perak, and promising fibre samples have been prepared.

343. A portable Hagotan stripper has been made by the Engineering Division for the State Agricultural Officer, Pahang. This machine was demonstrated at two Agricultural Shows and has performed well.

(ii) RAMIE

344. A two-year variety trial was completed in April at the Federal Experiment Station, Kuala Lumpur. Only at Serdang does agronomic research continue and excellent fibre samples have been prepared there.

(iii) JUTE

345. No agronomic research is now in progress on Agricultural Stations but small field trials have been conducted in Selangor with Segama jute grown as an off-season crop in the Tanjong Karang padi area. In the best-tended plot, grown by a Chinese smallholder, growth was excellent, the yield of fibre being equivalent to 1,799 lb. per acre. Harvesting and retting were said to be very laborious.

(iv) NEW ZEALAND FLAX

346. A seedling population of *Phormium tenax* grown at the Federal Experiment Station, Cameron Highlands, has shown such promising growth that 166 plants have been selected for further observation. This may well prove to be a suitable crop to grow in valley bottom peaty soils which are too wet for tea. Good fibre samples have been prepared.

(v) MAURITIUS HEMP

347. Good growth has been recorded at Serdang where this crop is being cultivated under different types of shade. Harvesting has not yet commenced.

348. Equally good growth has been noted on poor granite-wash soil in Penang.

(I).—Fruits

(i) BANANA

349. In a manurial trial which was planted at Ayer Hitam, Johore, in January, 1953, fruiting commenced in November, 1954. It was decided in October to increase the level of nitrogenous manuring as it appeared to have been fixed too low. The variety concerned is *Pisang Mas*.

350. A similar trial which was planted with *Pisang Serendah* in August, 1953, at Cameron Highlands is growing well and fruiting commenced towards the end of the year.

351. A third trial at Ampang Tinggi, Negri Sembilan, is proceeding less satisfactorily as soil conditions are unfavourable.

352. The variety museum at the Federal Experiment Station, Serdang, has been replanted on a better drained site.

(ii) RAMBUTAN

353. Very careful checking of clones in the variety trial at Serdang has revealed a number of rogues which date back probably to errors in budwood nurseries arising out of the mixing up of labels during the occupation of Malaya by the Japanese. These errors have not been discovered before since certain clones were new in 1941 and little was known about them. In one case, however, a rogue has arisen out of a natural mutation, since a yellow-fruited sport of the very distinct R. 99 has appeared. A good crop was being harvested from this trial at the end of the year.

354. The variety trial at Degong, Perak, gave its sixth harvest in December when the following average tree-yields were recorded:

R. 30	...	642	fruit
R. 9	...	506	„
R. 1	...	384	„
R. 5	...	311	„
R. 4	...	282	„
R. 84	...	77	„

The best growth has been shown by R. 84 followed by R. 30, 1, 4, 5 and 9.

355. Major advances have been made in the technique of propagation. Casualties at lifting have been reduced by transplanting at bud break rather than later and work is in progress on the rooting of semi-hardwood cuttings.

(iii) OTHER FRUITS

356. In a durian variety trial which was planted at Serdang in November, 1948, some of the trees were bearing their first crop at the end of the year. The opportunity was taken to re-test the quality of the clones concerned. A new and more intensive manurial programme has been planned for this experiment.

357. Excellent growth has been recorded in a cashew nut variety trial in Penang which was planted in June, 1953. Girth measurements taken one year later are summarized below:

MEAN GIRTH MEASUREMENTS IN CM. PER TREE					
Besut		Serdang		Penang	
15.0	..	10.6	..	15.2	..
				Mean	S.E.
				13.6	± 0.8461

Clearly the Besut and Penang strains are outgrowing the Serdang one.

358. Seed of *Annona cherimolia* has been imported from Poona, India, and young seedlings are being raised at Cameron Highlands.

359. A factorial manurial trial on King oranges at Degong, Perak, was designed to study the effects of N, P_2O_5 , K_2O , ground limestone and a mulch of organic matter on the quality and yield of fruit. Results to-date have been disappointing: fruit size has been very small; treatments appear to have no effect on quality and only nitrogen has an effect on yield. The soil type is a free-draining alluvial clay.

(J).—*Fodder Grasses*

360. Seven experiments have been concluded at Serdang during the year as they had served their purpose.

361. In a variety and manurial experiment conducted on Napier grass and its varieties, and hybrids the local variety gave the highest yield of fresh cut grass and averaged 44 tons per acre per year over a $2\frac{1}{2}$ year period. This high yield was only obtained on poor soil by using heavy dressings of fertiliser, especially of sulphate of ammonia, the quantities of this fertiliser ranging from 10 to 20 cwt. per acre per year.

362. Similar heavy yields of Guinea grass have been recorded from an intercultivation trial where 18 cwt. per acre of NPK fertilisers were applied every year in four applications. There is some evidence that it would pay to apply some fertiliser every six weeks, i.e., after each harvest, in order to maintain a high yield of grass and a high protein content.

363. Seed of five strains of Guinea grass has been imported from Kenya and of one strain from Tanganyika. Germination was poor, but adequate plants have grown to permit a comparison with local strains. Some of them appear to be very leafy indeed.

(K).—*Leguminous Fodders, Green Manures and Cover Crops*

364. A Stylo, *Stylosanthes gracilis*, manurial trial at Bachok, Kelantan, has been concluded because of poor conditions of growth. During the period July, 1953, to June, 1954, the mean yield of green matter was 34,324 lb. per acre, the significant effect of phosphate as basic slag being + 4,600 lb. per acre. Differences due to nitrogen, potash and lime were non-significant as were the first-order interactions. Yields from unmanured but better-drained fields of Stylo elsewhere in Kelantan have been considerably higher than the best at Bachok.

365. Clear evidence has been produced at Serdang that foliage of *Mimosa invisa* var. *inermis* is sometimes toxic to goats, when it causes death within 48 hours. Nine goats died as a result of eating a mixed fodder containing this foliage and a tenth died in a confirmatory test. The toxin concerned has not yet been determined in spite of analyses of stomach contents.

366. *Desmodium scorpiurus*, a cover crop which was imported from New Guinea in 1952, has been established at the Federal Experiment Station, Cameron Highlands, where it will be

tested as a ground cover for tea. It is growing vigorously there although it dies out after a period on the plains because of occasional damage by leaf-eating insects. It has the reputation of surviving under shade but it is not vigorous under such conditions.

367. The hybrid tree *Leucaena glabrata* × *glauca* has proved to be much more vigorous than either of its parents, and material has been bulked up by budgrafting on to *L. glauca* stocks. Unfortunately it cannot easily be propagated from cuttings so its usefulness is limited. Attempts are now to be made to root it in stool beds.

368. A series of trials has been laid down to study the effect on the growth and yield of padi of growing *Sesbania aculeata* during the off-season. This green manure can be established by broadcasting soaked seed into the ripe padi crop one week before harvest.

(L).—Pastures

369. A pasture establishment and grazing experiment which was laid down in 1947 has been concluded after recording yields of fresh grass for four years. Three types of shade were used, fruit trees, *Gliricidia sepium* and *Enterolobium saman*, but these were unreplicated. There were eight swards consisting of *Axonopus compressus*, *Paspalum dilatatum*, *Panicum maximum* and natural growth with and without a legume. The highest yields were given by Guinea grass with *Desmodium triflorum*, and *A. compressus* with *Centrosema pubescens*. The pastures were not manured and the mean yield of green matter was only 5.64 tons per acre.

370. It is not practicable at present to record liveweight gains from each plot so rotational grazing has been introduced and the experiment will be continued as an observation of the effects of the different shades.

371. The factorial manurial trial on *Axonopus compressus* under shade of *Enterolobium saman* has again revealed highly significant responses in yield to applications of sulphate of ammonia and muriate of potash. Once again basic slag failed to affect yield. The most interesting of the two-way tables is reproduced below for the overall period of January, 1952, to December, 1954:

YIELD OF FRESH CUT GRASS IN LB. PER ACRE PER YEAR

Cwt. sulphate of ammonia per acre	CWT. MURIATE OF POTASH PER ACRE						Mean
	0		1		2		
0 ..	31,800	..	34,020	..	33,950	..	33,250
2 ..	39,190	..	40,060	..	42,900	..	40,720
4 ..	43,530	..	46,690	..	49,120	..	46,450
S.E. ..	—	..	± 992.38	..	—	..	± 572.95

372. It will be seen that the N_2K_2 treatment produced a yield of 21.93 tons per acre per year over the three year period. The equivalent yields of protein have not yet been analysed.

373. Since responses to both nitrogen and potash were linear it may be assumed that heavier dressings would continue to produce additional responses.

374. Botanical observations on this trial have shown that both nitrogen and potash depress the growth of *Mimosa pudica*, and phosphate encourages sedges and, to a lesser extent,alang (*Imperata cylindrica*).

375. Hay grass, *Dicanthium caricosum*, is growing well in observation plots in Kedah, Kelantan and Selangor, but it is too soon to assess its value. Protein content is usually higher in the north than in Selangor.

(M).—*Vegetables and Food Crops*

376. In a variety trial conducted at Cameron Highlands to evaluate varieties of English cabbage new to Malaya, two varieties from Australia, namely Yates' Jubilee Hybrid and Yates' Allhead, yielded significantly better than the commonly grown "Japanese Succession" type. The compact hearts of Yates' Allhead and the similar yielding Sutton's Eclipse Drumhead were preferred by wholesalers to the loose-hearted Jubilee Hybrid. The two lowest yielding varieties, namely Sutton's Pride of India and Yates' Vanguard, which were the earliest maturing, were preferred in quality tests.

377. The vegetatively propagated "Japanese Succession" type of cabbage has continued to suffer from a suspected bacterial disease, and disease-free vegetative planting material of Yates' Jubilee Hybrid has been distributed to growers.

378. Further crops from the long-term vegetable manurial trial designed to investigate systems of manuring not associated with excessive fly breeding have been harvested. Differences between treatments are not now so clear cut as formerly; in fact in the last two crops, Lobak and French Beans, the otherwise undesirable prawn dust has given the highest yields. It is still too early to make any firm recommendations from the results of this experiment, especially in view of the complication introduced by heavy disease on a recent crop.

379. Growers trials with certain Japanese and Indian seed of two locally grown vegetables have this year given disappointing results. The superiority of some of these varieties as shown in trials on experimental stations at Cameron Highlands and Kuala Lumpur has not always been confirmed in the field. Such variations as occur between different strains of a variety, whether local or imported, necessarily limit the value of the information that can be derived from trials using any single strain of seed, especially when this is the control variety. These imported varieties, although often of good quality, appear to be more adversely affected by very wet weather than the local varieties.

380. Further variety trials with soya beans are being continued in conjunction with the Botany Division of the Research Branch, which is responsible for the selection work.

381. Five varieties of pigeon-pea, *Cajanus indicus*, have been imported from Jamaica and two from the Bahamas. These are

now being compared with the local Kedah variety in a replicated trial at Gajah Mati, Kedah, and in unreplicated blocks in Kuala Lumpur. The quick-maturing Bahamas Early variety promises to be a useful green vegetable for the home garden as the pea-size is large. This crop is not as widely used as it might be in Malaya where it is usually grown as a pulse to produce *dhal*.

382. An imported soft-shelled variety of Job's Tears, *Coix lachryma-jobi*, was grown at the Federal Experiment Station, Kuala Lumpur, during the year but did not show much promise. It proved to be slow to grow in the early stages and did not ripen evenly. The yield of unshelled grain was only 930 lb. per acre.

(N).—Miscellaneous Crops

383. Vines of Conophor Nut have declined in vigour at Serdang and no crop has been produced. A healthier growth has been reported at Gajah Mati in North Kedah where the vines are growing over mature Chiku trees, *Achras zapota*. A small harvest was collected from two plants and 34 nuts were submitted to the Chemistry Division of the Research Branch for examination. The crop cannot be said to be a promising one for Malaya.

384. Pharmaceutical research chemists continue to show considerable interest in the roots of the wild shrub *Rauwolfia perakensis* (Apocyanaceae) which is widespread in northern Malaya although nowhere particularly common. The medicinal value of the plant depends on its reserpine content as this alkaloid is used for treating hypertension. Because of the difficulty of collecting wild plants, *R. perakensis* has been brought into restricted cultivation in Kuala Lumpur, and there would seem to be no great difficulty in raising the plant in large numbers if it should become necessary. Reports from other countries indicate that the reserpine content of the Malayan species is inferior to that of the allied species *R. serpentina*, which has been recorded from India, Pakistan and south to Ceylon, Thailand and Java.

2.—LIVESTOCK

(A).—Goats

385. The Serdang herd was reduced during the year by the disposal of all Toggenberg animals.

386. In addition, 43 male animals were distributed to State and Settlement Agricultural Officers or to the public. These were:

	1/2	3/4	13/16	7/8	Pure-bred	Total
Anglo-Nubian ..	7	—	—	—	—	7
Saanen	2	9	4	6	2	23
British Alpine ..	—	8	—	—	5	13
Total ..	9	17	4	6	7	43

387. The herd now consists of 90 animals, 14 of which are pure-bred British Alpine, Saanen and Anglo-Nubian, and the rest are cross-breeds containing imported blood ranging from half to 31/32.

388. Recording of liveweights continued throughout the year and indicated that, among half-breds, the greatest liveweight increase was obtained by half-bred British Alpines, followed by Saanans and Anglo-Nubians in that order.

389. Recording of milk yields indicated that the pure-bred does, though giving satisfactory yields when compared with local animals, were outyielded by the cross-breds. The highest daily yield was achieved by a 7/8 bred Saanan, giving 3½ pints per day.

390. The goat feeding trial at Bukit Mertajam, Province Wellesley, is now proceeding more slowly as fewer animals are becoming available from Serdang. Some of the experimental animals turned out to be poor doers owing to late castration and these have been discarded. Animals fed on balanced rations produce a carcass somewhat too fatty for the Malay market although acceptable to other races.

(B).—Pigs

391. A pig feeding trial was completed during the year at the Serdang stock farm. It was designed to test the value of adding a proprietary feed supplement, containing vitamin B₁₂ and aureomycin, to a balanced ration fed to pigs from weaning to a slaughter weight of one pikul. There were twelve litter-replications in all and the results are summarized below:

		Mean Liveweight Increase in lb. per day		Mean Liveweight Increase in lb. per 1,000 lb. food
With supplement ..	..	0.8288	..	9.4987
Without supplement ..	..	0.8229	..	9.5017

Clearly the feed supplement had little or no effect on rate of liveweight increases and none on efficiency of conversion of food to flesh.

392. During the year, two Large Black, two Wessex and one Large White breeding boars were distributed for production of cross-bred animals with Chinese Black sows. The object was to make a rough comparison of the value of the different cross-breds to the trade. It was not possible to plan a more precise comparison because of the lack of suitable facilities at any one centre.

(C).—Bali Cattle

393. The Serdang herd has been maintained in a healthy condition throughout the year and observations have been made on liveweight increase and breeding performance.

394. Only fodder grass is fed to these animals, except just before and after parturition, yet an average liveweight increase of nearly ½ lb. per day was recorded.

395. Data from 14 calvings indicate that the gestation period ranges from 278 to 295 days with a mean of 285 days. Cows come on heat irregularly throughout the year but the most successful services occur in January and February.

396. Six calves were born during the year. Two bull calves have been distributed to State Agricultural Officers and two young bulls exchanged for bull calves.

397. The herd now consists of two bulls, five bull calves, six cows, two heifers and seven heifer calves.

C.—EXTENSION AND ADVISORY WORK

1.—CROPS

(A).—*Rubber*

398. Of a total area of 3,725,000 acres of rubber, no less than 1,695,000 acres are comprised of medium and smallholdings of less than 100 acres each. The Department is closely concerned with extension and advisory services to the owners of these medium and smallholdings and works in close association with the Smallholders' Advisory Service of the Rubber Research Institute of Malaya whose Instructors and Demonstrators operate throughout the country under the supervision of State or Settlement Agricultural Officers. The more important activities pursued in such association during the year included the demonstration and encouragement of the use of approved planting material, advisory work on new planting and replanting, control of pests and diseases, anti-erosion measures, and the use of fertilisers. Other lines of work undertaken, on a more local basis, were firstly, advisory work on the collection of smallholding rubber latex for centralised processing or for subsequent sale as latex to large exporting firms, and secondly, the survey of areas undergoing new planting. These surveys not only made it possible to keep a tally on the use of approved planting material, as stipulated in the express conditions attached to all new rubber planting titles, but also, by providing the State Agricultural Officer with accurate information of the whereabouts of land scheduled for planting and the progress made, has enabled him to plan, with a reasonable degree of accuracy, his nursery programmes for the production of approved planting material.

399. Although Government policy in general is directed primarily towards securing the maximum amount of replanting with high yielding trees and requires that replanting should normally take precedence over new planting, nevertheless, in those areas where ample land is available and where no alternative crop of equal or nearly equal economic value to rubber can be satisfactorily grown, new planting is being permitted by State and Settlement Governments. To meet new planting requirements funds have been placed at the disposal of the State and Settlement Agricultural Officers by their Governments for the establishment of budwood and clonal seedling nurseries.

400. It is suggested in this report (para. 22) that the Rubber Replanting Scheme in this country is, in importance and scope, unparalleled elsewhere in tropical agriculture. Its scope is certainly considerable, and in its successful operation the Department has an important part to play. On the Department devolves the responsible task of producing all the approved planting material required for the smallholders section of the Scheme.

401. Approved planting material takes the form of either budwood or clonal seedlings. In regard to the former, nurseries of the clones PB.86, Tj.1, RRI. M501 and M513 were maintained

on Agricultural Stations throughout the Federation totalling 94.7 acres, of which 40 acres were in full production and 54.7 acres in course of establishment. Compared with a total of 68,105 yards issued in 1953, 85,269 yards, i.e., an increase of 17,164 yards, were supplied to the Rubber Industry (Replanting) Board in 1954.

402. Clonal seedling stumps continued to be the type of planting material favoured by smallholders, and the policy was followed, as far as circumstances permitted, of establishing an adequate acreage of clonal seedling nursery in each State and Settlement to meet local replanting requirements. The nurseries, ranging from one to 50 acres and over, are sited on large rubber estates, smallholdings and Agricultural Stations and are managed either on contract or by direct labour. The total number of clonal stumps produced and issued to State Replanting Officers totalled 3,105,220, an increase over 1953 of 1,331,832 stumps.

403. The following tables give the total acreages of new and replantings on smallholdings and the distribution of improved planting material for the past four years:

		New Plantings		Replantings		
		(acres)		(acres)		
1951	..	5,588	..	3,778		
1952	..	6,725	..	4,250		
1953	..	6,339	..	21,971		
1954	..	*	..	27,730		
		1951	1952	1953	1954	
					New planting	Replanting
Budwood (yards)	..	39,489	46,936	68,105	37,295	85,269
Clonal seedlings	..	1,575,797	1,535,715	1,773,388	213,423	3,105,220
Seed	..	1,131,093	400,000	893,750	981,782	—

404. Nursery work on the large scale now practised requires a high standard of organisation, for a number of not readily predictable factors are involved such as the weight of seed-fall, viability of seed, and weather conditions at the time of establishment. As would be expected, mechanisation has been introduced wherever possible, but although trial mechanical sowings have been attempted, all ended in failure simply because the weather considered ideal for sowing and the conditions for operating machinery are not compatible. It is still the practice, therefore, for all seeds to be planted by hand, after germination in specially prepared beds.

405. Clonal seedlings are generally transplanted at an average age of nine months, that is, one year's sowing is the next year's planting. Seed collection during the latter half of 1954, in anticipation of clonal seed requirements in 1955, totalled 12,332,644 seed compared with 8,618,310 for the whole of 1953, and there was every prospect of the total reaching upwards of 17,000,000 before the end of the seedfall season in March, 1955. Collection was done by field staff of the Department and valuable assistance was received from officers of the Rubber Industry (Replanting) Board, who helped in the search for new sources of seed, and of the

* Not available at time of writing

Rubber Research Institute who, after examination of representative samples of seed, approved or rejected the sources once they had been found.

406. Wide publicity continued to be given to the need for strict control of lalang (*Imperata cylindrica*) on all holdings planted with young rubber, and where conditions were favourable a policy of inter-cropping with vegetables and food crops, having due regard to adequate manuring, was advocated. Attention to this aspect of extension is being drawn in Selangor where a newly opened Agricultural Station, situated on old rubber land adjoining the main north-south road near Kuala Kubu, is being used to demonstrate the various methods of replanting with emphasis not only on catch-cropping with short term crops but also on intercropping on a long term basis.

407. Centres established to collect latex from smallholders for centralised bulk processing or onward sale to exporters of boosted latex have not fulfilled their early promise, and in 1954 there was a further reduction in their numbers. Little or no centralised processing was being undertaken, for the system of immediate sale of the latex was undoubtedly the one better suited to cope with the vagaries of a changing market.

(B).—Padi

408. The key to success in extension work lies in the maintenance of an excellent farmer—Department of Agriculture relationship, and this principle is closely observed by the extension staff of the Department.

409. In addition to the eight large, purely experiment stations in the Federation, 38 smaller test stations, purposely sited to embrace the different sets of conditions encountered throughout the main padi-growing areas, are maintained and operated by the Field Branch of the Department. Their purpose is three-fold, firstly to accommodate extension trials with either fertilisers or new varieties, secondly to multiply improved strains for seed purposes, and thirdly to demonstrate improvements in techniques such as nursery management, spacing, and fertiliser application. Greater use has also been made in recent years of the Malay peasants' ready willingness to co-operate with the Department—a testimony, incidentally, of the friendly relations which exist—and in the 1954-55 season a total of 3,095 extension trials and demonstrations, 1,629 with fertilisers and 1,466 with new varietal selections, was planted on privately owned land. The number of such plots was limited by shortage of field staff and lack of funds, and not because the total was considered adequate for the purposes for which they were designed.

410. The Malay farmer, in common with farmers all over the world, is frequently described as conservative. That may be, but one thing is certain, which is that he is seed conscious to a marked degree and seldom neglects an opportunity of trying out a new variety or selection. This characteristic has been of great assistance in variety extension, and in Malacca and Negri Sembilan, where the selection programme has reached the stage of

controlled release of certain strains, there has been no lack of willing individuals to carry out trials. Serendah Kuning is the variety which does well and selections of which are under trial in Negri Sembilan. In the 1954-55 season, 60 one-acre seed farms under private ownership, all growing improved strains, namely Reyong 6 and Serendah Kuning 3, have been planted in Malacca. In the previous season the yields from similar seed farms had shown a 15 per cent. increase over the general average. Another promising selection, Subang Intan 16, has been released in the Langgar area of Kedah. Still another variety, Radin Kling, of short to medium maturation period, was shown to have distinct promise under the peculiar conditions pertaining to *padi menghulu** in Kelantan.

411. Demands for seed totalling 37,942 gantangs (gallons) were met from Departmental sources on a cash or exchange basis. The bulk of the seed comprised selected strains with the balance made up of rogued mass selected seed grown on Padi Stations.

412. Although striking results have been achieved in the east coast State of Kelantan from the application of economic dressings of a complete fertiliser mixture, the response in the third year to the Fertiliser Subsidy Scheme was most disappointing, barely sufficient being bought to apply to 2 per cent. of the planted crop as against approximately 4 per cent. the previous season. In terms of tons and acreages, this meant the purchase of 296 and 720 tons and the manuring of 2,960 and 7,200 acres, respectively. Lack of ready cash at the time of year when funds are at their lowest in the average peasant household was undoubtedly the main reason for the lack of success. Other factors quoted were the reduction in the rate of the subsidy and the still considerable feeling of reserve with which fertiliser application is regarded. In Trengganu, where the subsidy scheme is in its second year, the amount of fertiliser distributed was 49 tons, as compared with 53 tons in 1953.

413. No subsidy was granted to farmers on the west coast, but significant, if slow, progress in the application of fertilisers appeared to be taking place, particularly in Kedah where 5.67 tons of double superphosphate, 222.92 tons of Christmas Island rock phosphate and 263.2 tons of sulphate of ammonia were used. Contrasting data for 1953 are: phosphates 185 tons and sulphate of ammonia 211 tons.

414. From the foregoing it will have been noted that whereas a complete mixture is required in Kelantan, a pre-planting application of phosphate and a post-planting application of sulphate of ammonia suffice in Kedah. The obvious conclusion to be drawn from this is that fertiliser extension in the field is not as straightforward as one might expect.

415. Messrs. Imperial Chemical Industries (Malaya) Ltd. and the Department collaborated in the preparation of a leaflet to publicise the use of approved fertilisers. A total of 87,300 copies was distributed.

* The early maturing padi crop grown in Kelantan on low-lying river flats with fertile soil, where deep flooding occurs during the monsoon necessitating early harvest.

416. Past endeavours by the Department to extend the aggregate area double-cropped annually with padi have not been wholly successful, and experience indicates that for success the areas must be sufficiently large for pest damage to be as little concentrated as possible, close and regular supervision is essential, care is necessary in selecting only those farmers known to be co-operative, and, in the initial stages, some form of Government assistance may be necessary.

417. Off-season planting of padi fields with crops other than padi continued to be practised extensively in Malacca and Selangor. The Department strongly favours this system of farming, for trials have shown that the beneficial effect on the subsequent padi crop is considerable, and, moreover, the practice makes for a more stable economy.

418. Control of padi pests is a routine function of the staff of the Field Branch of the Department. Extensive use was made of zinc phosphide and barium carbonate in the preparation of poison baits for rats.

(C).—*Fibres*

(i) JUTE

419. Trials with jute as an off-season crop between main padi crops on the coastal muck soils of Selangor have shown considerable promise, and sufficient seed to plant 11 acres was released in 1954 to selected farmers. At the same time, a guaranteed price of 20 cents per lb. for the fibre was promised by means of a Rural and Industrial Development Authority scheme. In the event, although only 3 acres was planted, its obvious potentialities as a profitable off-season crop aroused considerable interest on the part of the farmers in the area and requests for seed to plant 150 acres in the coming season had already been received up to December. Before extension on any real scale can be achieved, however, improvements in the standard of processing will have to be introduced and a guaranteed price-cum-purchasing scheme evolved, operated, and continued until the market is established.

(ii) MANILA HEMP

420. On the coastal clays of the Perak River delta, Manila hemp can be grown effectively and endeavours are being made to develop and extend it as a smallholders' crop. A transportable Hagotan stripping machine developed by the Agricultural Engineers of the Department should go a long way to overcoming processing difficulties.

(D).—*Other Crops*

421. Under the terms of the Smallholders' Rubber Re-planting Scheme, a grant of the same order as that for rubber, i.e., a total of \$500 per acre, is payable for replanting rubber land with certain approved crops other than rubber. Not only did most of the planting material required come from Departmental sources, but approval to plant with a substitute crop was granted by the State Replanting Officer only after inspection of the area and authorisation by the State or Settlement Agricultural Officer or his representative. This was done in order to safeguard the

interests of the smallholder, for the poverty of some of Malaya's inland soils is well-known and it frequently happens that replanting with rubber is the only sensible course to be taken. The proportion of acreages of "Other Crops" to "Rubber" approved for planting in 1954 was 1 in 8; and applied for in 1955—1 in 10.

422. Fruit was the most popular of the approved substitute crops, followed, in descending order of preference, by coconut, coffee, padi, pineapple and sago.

423. The pineapple is an important smallholders' crop in Selangor, and 40 demonstration plots (cultural and manurial) were laid down by the Department in the more important pineapple growing areas.

(E).—Planting Material

424. With the establishment in all States and Settlements of clonal fruit nurseries, derived originally from selected mother trees of high repute, production of budded fruit trees, particularly durians and rambutans, for distribution to the public was increased considerably in comparison with previous seasons. This is well illustrated by the following table:

	1951	1952	1953	1954
Budded fruit trees distributed ..	13,331 ..	16,870 ..	26,781 ..	39,898

425. A total of 3,198 selected fruit tree seedlings was also distributed.

426. When the benefits derived from overhead spray irrigation, recently installed at fruit nurseries in several States, and the development of new nursery techniques are exploited to the full the present scale of distribution should increase substantially, with a corresponding drop in the sale price of budded fruit.

427. Surprisingly little interest has been shown so far in the development of commercial fruit farms for the sale of improved planting material. The emergence, therefore, in several States of a total of 20 small multiplication nurseries ranging from 1 sq. chain to half an acre in area under the guidance and direction of officers of the Field Branch of the Department was considered a promising start to a useful line of extension work.

428. Coffee is a crop in which interest has been stimulated by, firstly, the prevailing high price for beans and, secondly, its acceptance as a substitute crop for rubber in the Smallholders' Rubber Replanting Scheme. Upwards of 20,000 basketed seedlings were distributed by the Department in 1954.

429. In Selangor, a scheme was in hand to settle ex-Special Constables on pineapple smallholdings. The Department supplied over 600,000 suckers as planting material.

430. As a side-line, the production of flowering and shade trees is undertaken mainly on behalf of new villages and Government Departments. A total of 12,533 was distributed.

431. The Department does not enter the commercial market as a supplier of vegetable seed, but small quantities of improved types are always available free on demand to interested growers for trial. Also, when occasion demands, the Department assists

in the procurement of planting material, when it cannot be supplied from Departmental sources, from private growers, as in the case of groundnuts for a large Rural and Industrial Development Authority scheme in Kelantan and of pepper cuttings for growers in various parts of the country.

(F).—*Amelonado Cacao Seed Gardens*

432. Seed gardens of Amelonado cacao aggregating 85 acres are established in all States and Settlements; the total area in 1953 was 50 acres. The purpose of the gardens is two-fold; as a source of seed for smallholders when development of the crop is undertaken, and as centres to demonstrate techniques relating to cacao husbandry. In addition to these particular seed gardens, all of which have been established under thinned jungle, i.e., in accordance with presently accepted practice, there exists a number of observation plots in Perak and Pahang where the top shade is provided by fruit trees. These plots show distinct promise.

433. In pursuance of planned land use policies, certain States have taken steps to reserve certain areas still under jungle and possessing soil of high fertility for possible planting with cacao and other high-value crops. In this connection, Pahang has given a lead and the State Natural Resources Board, of which the State Agricultural Officer is Secretary, was engaged at the end of the year in preparing plans for development under cacao of a large area of volcanic soil in the Kuantan area.

2.—MECHANISATION

434. The demand for assistance by Departmental tractors in areas of established agriculture was smaller than in previous years and could be attributed, at least in part, to the emergence of commercial contractors in many States and Settlements. The problems of preparing padi lands by mechanical means have been largely solved although in point of fact the demand for tractor aid during 1954 came, in the main, from dryland cultivators.

435. During slack periods, Departmental tractors were engaged mainly on opening up and ploughing land in the vicinity of new villages; altogether 500 acres were ploughed and 100 acres cleared and the trees windrowed. In Selangor, where there is an extensive rubber replanting scheme in progress, Departmental tractors were employed for 1,909 revenue hours.

3.—LIVESTOCK

(A).—*Pigs*

436. It is the Department's policy to foster interest in the Middle White breed, and with this aim in view arrangements have been made for pure bred boars to be kept at stud in as many of the important pig rearing areas as is practicable. Stud centres in new villages are now too numerous for full records to be kept of production and services. Most rearers favour the first cross, and in consequence a considerable traffic, in which the Department assists, takes place between States in meeting demands for gilts of the Chinese Black. Although the opinion was once held that the Middle White is not a good mother and that the average litter

is small, an increasing number of breeders were prepared to breed from high-grade cross-bred and pure bred sows.

437. Sales of weaner stock from Departmental breeding centres were brisk, totalling 602, i.e., 310 boars and 292 gilts.

(B).—Poultry

438. The Department's policy aims at no more than meeting the public demand for pure-bred stock. Demonstration flocks of imported breeds—Rhode Island Reds, White Leghorns and Australorps—were kept at most Agricultural Stations and such local demand as existed was met by the distribution of cockerels, pullets, unsexed day-old chicks, and hatching eggs. Sales were as follows: cockerels 1,700, pullets 1,858, unsexed day-old chicks 1,198, and hatching eggs 9,640. The foregoing figures do not include data from the two Rural and Industrial Development Authority sponsored, but Departmentally operated hatching schemes. These schemes fulfilled a useful double purpose by helping to meet the heavy demands for day-old chicks and stabilising charges made by commercial hatcheries, of which a number existed in the various States and Settlements.

439. Despite the low fertility and hatchability rates experienced by most breeders of pure-bred poultry, there is, at least to judge by the ever increasing number of applications made to the Rural and Industrial Development Authority for loans, a steadily growing interest in poultry keeping. There have been so many failures amongst those would-be poultry breeders already granted loans, that loans are now granted only after applicants have undergone a short course held under the auspices of the Department on the basic principles of successful poultry husbandry. The high cost of feeding stuffs, both imported and locally produced, remained the major drawback to general success with poultry. The disease problem has been greatly lessened thanks to the inoculation campaign of the Veterinary Department.

440. Poultry leaflets to the number of 22,263 copies were prepared, printed in three languages and distributed by the Department.

(C).—Goats

441. Early in 1954 it was agreed that the Veterinary Department would be the sole importer of selected breeds but that extension work would be carried out by both the Agricultural and Veterinary Departments according to the local resources of each. No new importations, therefore, have been undertaken by the Department and work on goats was principally confined to bulking up herds of Saanan, British Alpine and Anglo Nubian at selected Agricultural Stations for eventual sale to the public.

442. Distributions in 1954 were as follows:

			Male		Female		Total
Saanan	..	..	27	..	20	..	47
British Alpine	..	..	11	..	11	..	22
Anglo Nubian	..	..	1	..	6	..	7
Total			39	..	37	..	76

(D).—Fishponds

443. The culture of *Tilapia mossambica* provides an easy, cheap and palatable source of animal protein to those living in inland areas where diets are generally deficient in this important body building ingredient. In the State of Kedah, excellent progress was made with the construction of ponds, the number increasing from 115 in 1953 to 400 in 1954.

4.—PESTS

444. Rats and bandicoots, the latter fortunately still confined to the northern States, continued to be the worst pests of padi, and upwards of one ton of zinc phosphide was distributed free in the form of poison baits. Successful kills were computed in Kedah at 76,866 rats and 8,000 bandicoots, and in Malacca at 19,513 rats.

445. Other general pests encountered are squirrels, monkeys and pigs. Ammunition was supplied on numerous occasions by the Department to permit organised shoots.

446. The Bombay Locust (*Patanga succinta*) caused damage in new clearings in Pahang but not on a scale comparable to 1953. Early application of Paris Green poison baits effectively controlled spread and kept damage to a minimum.

447. The incidence of damage by the Coconut Beetle (*Oryctes rhinoceros*) was decidedly on the increase and campaigns were launched in several States at the instance of the Department to destroy potential and actual breeding grounds of the beetle. In Johore and Penang, a practical example and lead were given by the Department clearing up all breeding grounds detected on State land.

5.—NEW VILLAGES

448. Officers of the Field Branch continued to be closely associated with the agricultural aspects of new villages, and on numerous occasions reported technically on land earmarked for agricultural use by new villagers as well as assisting in its development. Generally speaking, the majority of settlers in new villages on the West Coast have settled down and vegetable and pig production has reached a high level. Those on the East Coast are much less numerous but the position was less satisfactory. The administration in Kelantan in particular is faced with the problem of converting Malay farmers, traditionally used to shifting cultivation, to systems and practices of permanent land usage ensuring, in hilly country, that the conversion is carried out with proper regard to the basic need for soil conservation.

6.—SETTLEMENT SCHEMES

449. Land Settlement Schemes for time-expired Special Constables have occupied the attention of officers of the Field Branch in varying degree. Demands for planting material—of pineapple, fruit, coffee, etc.—were accorded priority and generally were fulfilled without appreciable delay; similarly with demands for poultry. Shortage of staff rendered it impossible for State and Settlement Agricultural Officers to give attention to individuals, but where group settlement had taken place considerable time was

devoted to close supervision of the work undertaken, for many of the settlers possessed no previous agricultural experience.

7.—RURAL AGRICULTURAL TRAINING

450. Emphasis continued to be placed on Rural Agricultural Training as part of the Department's activities, and the usual diverse lines were followed ranging from visits and lectures in villages to organised demonstrations and residential courses at Agricultural Stations.

(A).—*Courses at Agricultural Stations*

451. At Agricultural Stations in Kedah, Perak, Selangor, Pahang and Negri Sembilan rural training centres comprising inexpensive school buildings with hostel accommodation attached were erected with funds made available by the Rural and Industrial Development Authority. These centres are an ideal means of providing local farmers with a variety of practical courses on crop and animal husbandry. They have proved extremely popular and in all cases there is a waiting list of applicants. The courses may, according to subjects dealt with, last from one to eight weeks and cater for six to 20 trainees at any one time. In 1954, 23 such courses were held. Plans are in hand to extend the system to all States and Settlements in 1955.

(B).—*Civics Courses*

452. Civics Courses have come to be accepted as part of Government's drive to create a feeling of civic consciousness among the people. The Department has always played its part in these courses and endeavoured to demonstrate particular agricultural services available to the public and to explain how best the farmer can make contact with its officers when in need.

(C).—*Lectures and Talks*

453. Lectures and talks given by the field staff of the Department were too numerous to detail, but it can be stated that the fullest use was made of film strips, slides and broadcast vans belonging to the Department of Information Services.

(D).—*Padi Competitions*

454. The holding of simple padi competitions is considered one means of developing "seed consciousness." Competitions organised by the Field Branch of the Department were held at *mukim**, district and State level and culminated in an All-Malaya Competition staged under the auspices of the Malayan Agri-Horticultural Association. The intention is to make these competitions an annual feature.

(E).—*Agricultural Newsletter*

455. Agricultural newsletters printed in the vernacular and expressly edited with a local bias were published and distributed free in three States. The increased correspondence received after

*Mukim=a parish

the issue of each number bore witness to the fact that the publications were read and moreover had stimulated the interest of the farming communities. This is considered an important line of extension as it makes for the maintenance of an even closer link than now exists between farmers and the Department.

D.—AGRICULTURAL EDUCATION

1.—ADVISORY COUNCIL

456. Mr. P. A. Rogers resigned from the Council during the year and his place is still vacant. Mr. Rogers' connection with the College had been a very personal one and he was one of the longest-serving members of the Council.

457. The Council met twice during the year, on the 10th February and on the 21st July.

2.—COLLEGE YEAR

458. The year was divided into three terms, as under:

3rd term, 1953-54, session—13th January to the 10th April.

1st term, 1954-55, session—15th June to the 3rd September.

2nd term, 1954-55, session—28th September to the 15th December.

3.—REGISTER OF STUDENTS

459. The categories of students in training were composed as follows:

Register of Students, June, 1954

Category	Malays	Chinese	Indians	Others	Total
DIPLOMA COURSE					
THIRD YEAR STUDENTS (1952-55)					
Federal Scholars	6	2	3	—	11
Agricultural Subordinate Major Scholar, Research Branch ..	1	—	—	—	1
Agricultural Subordinate Major Scholar, Agronomy Branch ..	1	—	—	—	1
Agricultural Subordinate Major Scholar, Kedah	1	—	—	—	1
Rubber Research Institute Students in training	1	3	—	—	4
Singapore Scholar	—	1	—	—	1
Assistant Rural Development Officers in training	2*	—	1*	—	3
	12	6	4	—	22
SECOND YEAR STUDENTS (1953-56)					
Federal Scholars	5	6	2	—	13
Private Students, Federal	—	2	—	—	2
Rubber Research Institute Student in training	1	—	—	—	1
North Borneo Student in training	1	—	—	—	1
	7	8	2	—	17

* Admitted as from the 2nd term, 1952-53, session

Category	Malays	Chinese	Indians	Others	Total
FIRST YEAR STUDENTS (1954-57)					
Federal Scholars	6	8	1	—	15
Private Students, Federal	—	4	1	—	5
Negri Sembilan State Scholar	1	—	—	—	1
Singapore Scholar	—	1	—	—	1
	7	13	2	—	22
MINOR COURSE (1954-55)					
Probationer Junior Agricultural Assistants in training	11	—	—	—	11
Private Students, Federal	2	—	—	—	2
Malay School Teachers in training, Perak	2	—	—	—	2
Malay School Teacher in training, Selangor	1	—	—	—	1
North Borneo Students in training	2	—	—	—	2
Brunei Students in training	2	—	—	—	2
	20	—	—	—	20
GRAND TOTAL ..	46	27	8	—	81

460. Of the above, one Probationer Junior Agricultural Assistant in training (Malay) had his services terminated by the Selangor State Government owing to unsatisfactory progress at the College.

4.—TRAINING

461. The training in the Diploma Course followed the same general lines as before. Practical field work was carried out on the adjacent Federal Experiment Station, with the active co-operation of the officers staffing the Station. This has continued to provide a valuable part of the training.

462. The Minor Course students spent three days in Malacca on padi work.

463. Instructional visits were arranged to as many places as possible, and included—

Headquarters laboratories, etc., Kuala Lumpur.

Cheras and Setapak Agricultural Stations, Selangor.

Padi areas and places of agricultural interest in Malacca, Penang and Province Wellesley, Perak, Cameron Highlands, and Tanjong Karang, Selangor.

Industrial areas in the Klang and Kuala Langat districts of Selangor.

5.—HEALTH AND RECREATION

464. The health of the students and labour force was good.

6.—CATERING

465. This has remained a staff responsibility. The Registrar and Bursar carried out the duties of Hostel Superintendent in addition to his own duties throughout the year.

7.—GENERAL

466. A Staff Refresher Course for Agricultural Assistants was held at the College from the 18th to the 22nd May.

467. In addition, Budding Courses for Junior Agricultural Assistants and Plant Propagators were held from the 6th to the 18th September.

E.—PUBLICATIONS AND LIBRARY

1.—PUBLICATIONS

468. Of the principal publications of the Department, that is, the *Malayan Agricultural Journal* and Special Bulletins (General, Scientific, Economic and Mechanisation Series), only the Journal was published in 1954. Due to shortage of funds it was found possible to print only two of the series of poultry leaflets mentioned in the Report for 1953 as being in course of preparation. The leaflets, "Systems of Poultry Keeping" and "The Feeding of Poultry," were printed in the English, Malay and Chinese languages.

469. The Department continued to supply the item "Notes from the Department of Agriculture" to the Department of Information Services for publication in the Malay and Chinese newspapers *Panduan Ra-ayat* and Farmer's News.

470. The Sub-Committee for Vernacular Publications was enlarged during the year to include one more Malay member.

471. The following summary shows which publications were printed during the year, together with the number of copies sold or issued free:

	English	Sales	Free and Exchange	Total
MALAYAN AGRICULTURAL JOURNAL—				
Vol. 36, No. 4		506 ..	869 ..	1,375
Vol. 37, No. 1		472 ..	881 ..	1,353
Vol. 37, No. 2		485 ..	869 ..	1,354
Vol. 37, No. 3		475 ..	862 ..	1,337
				5,419

LEAFLETS (Printed)—

Poultry in Malaya:

1. Systems of Poultry Keeping:

Poultry Leaflet No. 1	English ..	2,626 ..	2,626
	Malay ..	4,256 ..	4,256
	Chinese ..	4,251 ..	4,251

2. The Feeding of Poultry:

Poultry Leaflet No. 3	English ..	2,626 ..	2,626
	Malay ..	4,253 ..	4,253
	Chinese ..	4,251 ..	4,251

Malayan Agricultural Journal, Vol. 37, No. 4, is to be issued in early January, 1955.

472. The following summary shows the number of back numbers of the various publications of the Department distributed during 1954:

	Sales	Free and Exchange	Total
Malayan Agricultural Journal	348 ..	103 ..	451
Malayan Planting Manual No. 2	65 ..	3 ..	68
Special Bulletins	49 ..	125 ..	174
Agricultural Leaflets	— ..	6,080 ..	6,080
Poultry Leaflets	— ..	401 ..	401
Grow More Food and Educational Series. Leaflets	— ..	4,269 ..	4,269
Malay Agricultural Journal	— ..	95 ..	95
Leaflets in Malay	— ..	6,006 ..	6,006
Chinese Agricultural Journal	— ..	18 ..	18
Leaflets in Chinese	— ..	110 ..	110
Tamil Agricultural Journal	— ..	28 ..	28
Leaflets in Tamil	— ..	9 ..	9
			<u>17,709</u>

473. The following is a summary of all publications sold and distributed during the year:

	Sales	Free and Exchange	Total
English	2,400 ..	19,714 ..	22,114
Malay	— ..	14,610 ..	14,610
Chinese	— ..	8,630 ..	8,630
Tamil	— ..	37 ..	37
	<u>2,400 ..</u>	<u>42,991 ..</u>	<u>45,391</u>

474. Comparative figures for total revenue received during 1953 and 1954 from the sale of publications and from advertisements are as follows:

	1953	1954
	\$ c.	\$ c.
Sale of publications ..	5,333 29 ..	5,254 50
Advertisements ..	2,090 25 ..	1,979 72
	<u>7,423 54 ..</u>	<u>7,234 22</u>

2.—LIBRARY

475. The Library contains about 3,600 books and reports published in book form and nearly 29,000 volumes of periodicals. There are approximately 1,060 unbound volumes of periodicals which are of earlier years and incomplete. The Library also contains many thousands of pamphlets and reprints. Approximately 1,350 periodicals are available.

476. Over 150 periodicals and all annual reports are circulated to members of the staff as they are received.

477. Space in the Library is now at a premium and it is expected that additional floor space for new shelves will be made available in 1955.

F.—SCHEMES SPONSORED UNDER THE COLONIAL DEVELOPMENT AND WELFARE ACT (U.K.)

478. Brief particulars are given below of development schemes in progress under the control of the Department.

479. *Scheme D. 2115.*—A grant of £35,000 (\$300,000) was approved for the purpose of research and development work directed at establishing a cacao industry in Malaya. The scheme is designed to cover the period 1st January, 1954 to 31st March, 1956.

480. Investigations on cacao cultivation commenced in 1949 and much progress has been made, but these investigations have not yet reached the stage when conclusive recommendations can be made, and there is, therefore, a pressing need to continue research, more particularly on cultivation techniques in general. Expenditure in 1954 was \$59,586.86.

481. *Scheme D. 2203.*—A grant of £15,658 (\$134,211) was approved for a survey and investigation into the economics of padi production. The purpose of these investigations is to obtain an accurate assessment of the padi cultivator's true cost of production and to investigate other problems which are believed or known to affect production and which require detailed investigation. In addition, the survey will provide the basic information on the various factors upon which a sound policy for expanding rice production can be based. This scheme, administered in co-operation with the University of Malaya, commenced in 1954 and is due to end on the 31st March, 1956. Expenditure in 1954 was \$37,108.95.

482. *Scheme D. 2225.*—A grant of £31,900 (\$273,428.57) was approved for investigations into mechanisation of rice cultivation. The scheme is designed to assess the possibilities of mechanisation essentially as an aid to padi cultivation by the smallholder. It is proposed to begin a pilot mechanisation scheme of 50 acres sited in an area where through the construction of drainage and irrigation works a considerable amount of new land can be opened up for padi cultivation. The aim and object is to discover whether, with the aid of complete or partial mechanisation, a cultivator can plant a considerably larger acreage than he does at present thereby (a) producing a greater surplus of padi for disposal and (b) enhancing his standard of living.

SECTION V

AGRICULTURAL LEGISLATION

1.—IMPORTATION OF PLANTS (AMENDMENT) ORDER, 1954

483. The Importation of Plants Orders, 1747-1953, require that all living plants and parts of living plants (except seeds)

when imported into England and Wales for planting should be accompanied by a prescribed Certificate of Health, based on an inspection of the plants made within 14 days prior to the date of shipment. This order requires, for certain plants, an additional Certificate of Health based on examination of the plants during growth.

484. Legal Notification 381 of the 29th June, 1954, refers.

2.—PROHIBITION OF IMPORTS—OPEN GENERAL LICENCE

485. Plants, including living plants of all species, flowers, fruits, leaves, roots, tubers, cuttings, etc.

486. Legal Notification 600 of the 21st October, 1954, refers.

3.—THE RUBBER INDUSTRY (REPLANTING) FUND ORDINANCE, 1952

487. Scales of grant to smallholders for replanting with crops other than rubber.

488. Legal Notification 741 of the 23rd December, 1954, refers.

R. G. HEATH,

*Acting Director of Agriculture,
Federation of Malaya*

APPENDIX I

COMPARATIVE ACREAGES OF AGRICULTURAL CROPS

	1949 Acres	1950 Acres	1951 Acres	1952 Acres	1953 Acres	1954 Acres
Rubber	3,364,460	3,358,251	3,535,221	3,612,820	3,727,540	*
Oil Palm	90,507	95,982	97,377	100,182	108,265	109,643†
Coconut	499,610	509,289	509,306	512,967	512,744	498,093†
Padi (Rice)	908,070	930,530	875,390	831,050	834,010	845,990
Total	4,862,647	4,894,052	5,017,294	5,057,019	5,182,559	*
FOODCROPS:						
Tapioca	41,341	35,461	27,411	23,428	28,183	30,947
Sweet Potato	18,922	17,091	10,843	13,449	16,735	19,274
Sago	6,738	6,224	6,467	6,364	6,826	6,954
Sugar Cane	2,346	1,989	2,055	1,861	2,008	2,050
Groundnut	1,027	1,755	1,943	2,479	2,485	2,785
Maize	806	2,583	2,997	7,332	4,224	8,849
Yam	621	1,107	1,077	1,101	1,099	1,436
Colocasia	3,354	2,892	3,072	3,390	3,404	3,278
Ragi	37	*	39	25	111	158
Soya Bean	63	*	106	117	152	223
Pulses	548	*	784	1,569	1,945	1,556
Vegetable (Market Gardens)	13,167	10,844	10,671	12,640	14,910	13,106
Total Foodcrops	88,970	79,946‡	67,465	73,755	82,082	95,616
FRUITS:						
Pineapple	17,239	23,981	24,468	24,843	23,930	27,949
Banana	57,629	48,150	39,988	40,257	48,508	56,384
Cashew Nut	2,049	2,207	2,102	2,120	2,105	2,134
Specified Fruits	32,914	66,547	*	*	*	*
Mixed Fruits	77,264	34,940	*	*	*	*
Durian	*	*	25,270	26,652	27,394	28,301
Rambutan	*	*	14,779	15,848	17,951	17,850
Mangosteen	*	*	7,342	8,025	8,561	8,588
Citrus Fruits	*	*	2,064	2,312	2,854	3,387
Other Mixed Fruits	*	*	41,823	41,889	42,314	42,344
Other Fruits under Sole Crop	*	*	2,925	2,210	—	—
Total Fruits	187,095	175,825	160,761	164,156	173,617	186,937
SPICES:						
Arecanut	48,957	48,391	47,659	44,862	46,300	45,417
Chillies	2,490	2,291	2,212	3,258	3,768	4,159
Pepper	80	148	156	204	377	678
Cardamom	5	2	1	—	1	—
Ginger	1,447	1,238	976	1,013	974	1,263
Sireh	2,438	2,768	2,729	2,900	2,983	3,100
Nutmeg	70	77	80	59	55	54
Cloves	293	283	226	195	183	176
Turmeric	1,120	889	838	731	959	1,097
Total Spices	56,900	56,087	54,877	53,222	55,600	55,944
MISCELLANEOUS:						
Tea	9,413	8,434	8,497	9,561	8,719	*
Coffee	9,507	8,951	7,435	9,299	9,286	10,557
Cacao	*	*	531	295	302	418
Tobacco	1,457	408‡	2,109	3,830	2,579	4,489
Derris	297	571	428	244	426	463
Nipah	33,438	33,559	33,472	33,749	34,105	34,425
Gambier	532	986	831	932	908	910
Kapok	1,770	1,720	1,567	1,411	1,675	1,579
Ipecacuanha	257	219	179	250	143	143
Patchouli	32	37	16	8	37	81
Citronella	20	12	19	27	29	30
Gutta Percha	5,635	3,471	5,635	5,635	5,635	5,471
Other Miscellaneous	753	657	1,213	1,437	1,448	1,494
Total Miscellaneous	63,111	59,025	61,932	66,678	65,292	*
TOTAL ALL CROPS	5,258,723	5,264,935	5,362,329	5,414,830	5,559,150	*

* Not available. † Provisional. ‡ Incomplete.

